



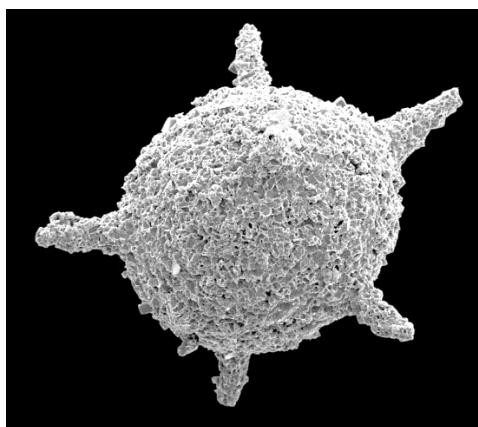
*INTERNATIONAL UNION OF
GEOLOGICAL SCIENCES
COMMISSION ON STRATIGRAPHY*

—S—D—S—

**SUBCOMMISSION ON
DEVONIAN STRATIGRAPHY**

NEWSLETTER No. 38

**R.T. BECKER, Editor
Münster University,
Germany**



SDS NEWSLETTER 38

Editorial

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

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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, **38**: x-y.”

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CHAIRMAN's Address

Dear SDS Members,

It is my pleasure to state that the year 2023 was busy and rich in Devonian activities. I will try to summarize the most important ones in these opening words to our SDS Newsletter No. 38. Our Newsletter informs, on an annual basis, about everything related to the Devonian, being put together mostly from your contributions. I wish to take the opportunity to thank you all again for sharing Devonian information. At the same time, I encourage you to continue reporting all your Devonian-related activities, events and promotions to provide the next issues with exhaustive information.

Apart from many Devonian papers that appeared since our last SDS Newsletter, some of us were busy with the two big issues that have to be resolved by our Subcommission – the redefinition of the basal Emsian GSSP and (with the Carboniferous Subcommission) the redefinition of the Devonian/Carboniferous boundary. In the last few years, a big progress has been made in the restudy of the basal Emsian boundary. Devonian teams are working in several areas including the Pragian Stage stratotype area in the Prague Synform, in Spanish Central Pyrenees, or in the Moroccan Meseta. As it has been already announced by the SDS some time ago, proposals from all regions, including the Kitab State Geological Reserve in Uzbekistan, are welcome. We hope that first proposals will be ready for a discussion during the next year. In the meantime, the Devonian/Carboniferous Boundary Working Group is busy with the definition of multiple criteria that would work in various environments for a safe recognition of the system boundary.

Organization of face-to-face meetings has fortunately returned to the normal, and we were enjoying the opportunity to meet at several events during the last 12 months. The regular 2022 SDS Business meeting took place in conjunction with the 6th International Palaeontological Congress in Khon Kaen,

Thailand in November 2022, after a long period of the pandemic. It was the first non-virtual SDS business meeting since Milano 2019! At the SDS meeting, we recruited several new SDS members, and the entire IPC that was excellently organized was a highly refreshing event. In conjunction with the IPC we organized a Devonian symposium, *Devonian palaeoenvironments and mass extinctions*, with 15 contributions.

In July 11–13, many Devonian people met at STRATI 2023 (the 4th International Congress on Stratigraphy) in Lille, France. The SDS held an informal meeting and a Devonian session with 18 talks and posters. The business meeting of the International Commission on Stratigraphy (ICS) took place as well, face to face again after 4 years. As the CHAIR of the SDS, I gave a report on our activities and the current state of our Subcommission to the ICS.

The long-planned and several times postponed SDS meeting in Geneseo, with field trips from Ohio to the New York State, did finally take place, ending only few weeks before I was writing these lines. It was the most important event for our community directly focussed on the Devonian, and it was very successful, perfectly organized, and highly attended, including the regular SDS business meeting. Excellent field-trip guidebooks were produced for the pre-, intra- and post-meeting field trips. Minutes from the last four SDS business meetings are available in this Newsletter.

For the NY meeting, an extensive monograph titled "Devonian of New York", edited by C. A. VER STRAETEN, D. J. OVER, and D. WOODROW in 3 volumes of the *Bulletins of American Paleontology*, has been published. It was presented at the meeting banquet at the Paleontological Research Institute in Ithaca. Several thematic volumes were announced to be issued within next years. Please, see the information in the Newsletter and consider your contribution. The IUGS International Commission on Geoheritage has already published "The First 100 IUGS Geological

Heritage Sites” and the pioneer book includes Klonk (the GSSP for the Silurian/Devonian boundary at Klonk Hill near Suchomasty) as the first GSSP in the World.

As time is running very quickly, the year 2024 will mark a change in the ICS executive and a change in most stratigraphic subcommissions. Our team of SDS officers on duty is willing to continue for the next term unchanged: Ladislav SLAVÍK (Chair), Nacho VALENZUELA-RÍOS (Vice-Chair), Uli JANSEN (Secretary), and Thomas BECKER (SDS Newsletter editor), but forthcoming confirmation by voting members is necessary. Some changes at the level of voting members will be needed. We have already started to seek new voting members to replace those, whose service has already expired but who are expected to continue as active CMs.

The new SDS web, launched in 2021, is housed on the ICS webpage. It is also a storage of our SDS newsletters. The change was possible mostly due to the work by Carlo CORRADINI and Nick CAR (ICS webmaster). The SDS thanks CARLO for all his work with the SDS website: he asked for a termination in his position due to many other duties, and the SDS will have a new webperson Sofie GOUWY, for the next term.

I am glad to conclude that our community was very active within the last 12 months. Many thanks for all your Devonian-related work, organization of meetings, publications, education of students, protection of Devonian localities, and many other directions of scientific production!

I wish you all the best!

Prague, August 2023

Ladislav SLAVÍK

(SDS CHAIRMAN)

OBITUARIES

Pierre BULTYNCK

(12.6.1938 – 27.11.2022)

**R. Thomas BECKER &
Katarzyna NARKIEWICZ**

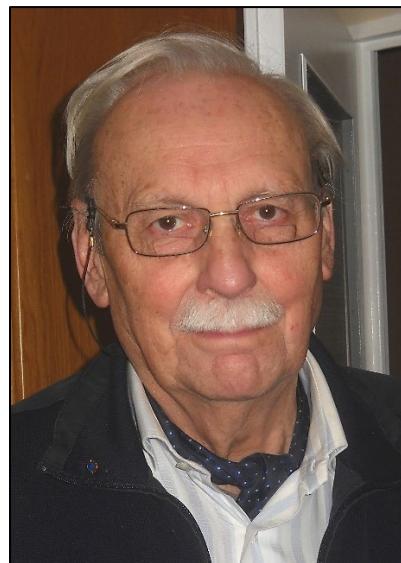


Fig. 1. Pierre BULTYNCK.

Our long-term SDS member and former Chairman Pierre BULTYNCK was born 1938 in Leuven (Belgium), where his childhood was affected by the Second World War and the following major reconstruction. He went to the Sint Pieterscollege, where his teachers rose his interest in the complexity of nature and the cosmos, suggesting that he should study geology, a topic that was not widely popular at the time. In fact, he was one of only five students to graduate at Leuven in 1961 and among them, he was the only one to pursue afterwards a career in geology and palaeontology. In December 1961 he got married to Mia POTARGENT.

In the following years, Pierre conducted a Ph.D. project on “*A stratigraphic and palaeontological study of the Couvinian type profile*”. It was supervised at Leuven by Marius J. LECOMPTE, famous for his work on Devonian reef builders. The research was supported by grants from the Natural Science Foundation and the Institute for the Promotion of Research in Agriculture and Industry. During this time, he

also had to do army service. Ph.D. results were published in 1966-1970, partly (the foraminifers) with N. MOURAVIEFF. Pierre's work confirmed the importance of conodont biostratigraphy, which was rapidly evolving at the time, not only for pelagic, but also for neritic successions. Through the international recognition of his work, he was awarded in 1968 an Alexander von HUMBOLDT grant.

From 1971 on, Pierre joined the Royal Belgian Institute of Natural Sciences, where the late CM Paul SARTENAER was already working as a Devonian specialist. Because of his friendly and inspiring personality, communication and organization skills, he climbed the hierarchical ladder. In January 1991 he became the head of the Palaeontology Department, remaining in this position until his retirement. Before that, in 1973, he was appointed as an external Professor of Palaeontology at the University of Leuven, where he taught *Stratigraphical Palaeontology* and *Micropalaeontology* (with Etienne STEURBAUT) for more than thirty years. Of course, this included field trips and practicals in the Devonian Givet, Couvin, and Phillippeville regions. He supervised many M.Sc. and several Ph.D. theses, and students from abroad. He presented the external professors at the faculty council and contributed to the development of the curricula, for example when the B.Sc./M.Sc. system was introduced. A further part was his museum work, for example his contribution to the renewing of the *Iguanodon* exhibition, which is both very modern and impressive now, or to chair the organization of an exhibition on the evolution of life that opened at the end of 2005, after his retirement in 2003.

Pierre had the reputation as one of the world leading specialists for Devonian conodonts, especially for the Emsian to lower Famennian interval. His research covered many regions including the Sierra de Guadarrama in central Spain, Michigan in the US, the Anti-Atlas and Meseta of Morocco, the Montagne Noire, Boulonnais and Bretagne of France, the Holy

Cross Mountains and Radom-Lublin areas of Poland, the Carnic Alps, the Belarussian Basin, or the Moose River Basin of Ontario, Canada. This was based on close international cooperation with many well-known Devonian workers (mostly SDS members), such as Z. BELKA, M. BENSAID, D. BRICE, J. L. GARCÍA-ALCALDE, H. HOLLARD, H. LARDEUX, P. MORZADEC, P. R. RACHEBEUF, G. RACKI, C. SANDBERG, T. UYENO, O. H. WALLISER, M. WEYANT, and W. ZIEGLER. He was much interested in the correlation of other fossil groups, such as goniatites, palynomorphs, brachiopods, and corals, with the conodont sequence. Together with his Ph.D. student Sofie GOUWY, he explored the enormous potential of graphic correlation to supplement the classical biozonations. Several other (at the time) young conodont workers benefited enormously from his openness and generosity to share freely his experience and expertise, for example Mustafa el BENFRIKA, Sarah ABOUSSALAM, and the co-author.

There was also a strong focus on the classical Devonian of the Ardennes. Numerous contributions with many Belgian colleagues led to a much improved understanding of litho- and biostratigraphy, and of the complex facies development in the various subregions. For the long list of collaborators, too many to be listed here, see all the (co-)authors in the publication list. Outstanding in international comparison are the compilations of Belgian lithostratigraphic units: BULTYNCK et al. (1991) for the Middle Devonian; BOULVAIN et al. (1999) for the Frasnian; BULTYNCK & DEJONGHE (2001) for a volume on all Belgian lithostratigraphic units.

The wealth of his conodont contributions (see the long publication list) earned him in 2013 the PANDER Medal, which was awarded at the SDS Field Meeting in Morocco, in a hotel in Erfoud. This place was most suitable with respect to all the conodont research that he had conducted during several decades in Morocco.



Fig. 3. Group photo of the SDS field meeting in the eastern Anti-Atlas in spring 2013, with Pierre sitting in the middle-right (second row) just behind Ahmed EL HASSANI, on the afternoon after he had received the PANDER Medal.

From 1974 on, Pierre worked with the Devonian Subcommission, became first Titular Member, then SDS SECRETARY (1992-1996), and then SDS CHAIRMAN for the eight years period from the International Geological Congress in summer 1996 in Beijing to the IGC in Florence in summer 2004. He was also Chairman of the Belgian Devonian Stratigraphic Commission and Belgian National Geological Council. But Pierre was too modest and polite to accept the request to be nominated for the ICS presidency.

The Devonian workers may not know that Pierre also stimulated significantly the exploration and investigation of Cretaceous mammals and dinosaurs in Asia. In terms of organization, logistics, and communication, this was a difficult task but it contributed largely to the high reputation of the Royal Belgian Institute. His interest in vertebrate palaeontology included also projects on the famous Belgian iguanodontids, causing him to write a popular book on these. And it is the reason, why Cretaceous fish remains were named after him. Apart from this, Pierre initiated the study of Jurassic marine reptiles from the Belgian Lorraine. Many SDS and IGCP 596 members will well remember the splendid conference dinner that we had 2015 in the museum in Brussels, with the *Iguanodon* herd as the background scenery.

After his retirement in 2003, Pierre continued his active research, contributing to more than 25 publications. This included the important full descriptions of the conodont faunas across the Eifelian-Givetian boundary in the Jebel Mech Irdane GSSP area (WALLISER & BULTYNCK 2011), many joint papers with Kasia (see below), and a thick paper on the Emsian conodont stratigraphy of the Anti-Atlas with Sarah ABOUSSALAM and Thomas. After 2016 his health declined and eventually it became impossible to carry on with work at the institute. The pandemic made the situation worse.

With Pierre, the Devonian community lost not only an outstanding scientist but also an extraordinary, warm, always humorous, and inspiring person. He is survived by his daughters Annemie and Katrien and their families. Both were honored in 1989 by the naming of two lower Emsian polygnathids, *Po. annamariae* and *Po. catharinae*, after them. Much earlier (BULTYNCK 1971), he had thanked his loved wife Mia by introducing *Spathognathodus steinhornensis miae* [now *Criteriognathus miae*]. These were only small parts of Pierre's scientific achievements that will remain entrenched in our knowledge of the Devonian world.

Taxa named after Pierre BULTYNCK:

Comura bulyntcki MORZADEC, 2001 [asteropygid trilobite]
Icriodus costatus bulyntcki DREESEN & HOUTLEBERGHS, 1980
Caudicriodus bulyntcki GARCÍA-LÓPEZ, 1987 [a junior homonym if *Caudicriodus* is not recognized as a separate genus from *Icriodus*]
Elops bulyntcki NOLF, 2004 [Aptian otolith]
Eocostapolygnathus pierrei BARDASHEV, WEDDIGE & ZIEGLER, 2002
Eucharitina bulyntcki GARCÍA-ALCALDE & HERRERA, 2015 [Lochkovian brachiopod]
Icriodus bulyntcki ASHOURI, 2006 [an un-replaced junior homonym]
Libanechelys bulyntcki TAVERN, 2004 [Cenomanian early eel]
Polygnathus linguiformis bulyntcki WEDDIGE, 1977
Spathognathodus bulyntcki GROESSENS, 1971 [now a species of *Eotaphrus*]
Tortodus bulyntcki ABOUSSALAM, 2003



Fig. 3. Pierre enjoying a sunny afternoon with Albert EINSTEIN on a bench near the beach in De Haan, where EINSTEIN lived for six months in 1933.

Acknowledgement

This obituary benefitted from information supplied by Katrien BULTYNCK and exploited a homage by Noel VANDENBERGHE and Anni DHONDT written at the occasion of his retirement.

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(from last to first, including only selected abstracts with data that were not fully published)

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Fig. 1. Pierre BULTYNCK between Marek (left) and Kasia Narkiewicz (right) in 2004.

In memory of Pierre BULTYNCK

Katarzyna NARKIEWICZ

First time I met Pierre in 2002 during the Eighth International Conodont Symposium in France, half a year before his retirement. He was a well-known and admired person in the circle of the conodontologists. He was also the Chairman of the Subcommission on Devonian Stratigraphy. While working on my doctoral thesis, I have been studying Middle Devonian conodonts from Poland, the important part of which were icriodids. And Pierre studied this long under-estimated group since the Sixties of the last century. He had been proving that this difficult group is very diverse and useful for

biostratigraphy. In my material, he saw the evidence supporting his guesses, e.g. on the subdivision of the Givetian Stage – as widely known from the Ardennes. He decided to support myself by persuading me to obtain the EU grant called “Access” to the Belgium Collections - which I eventually did. I packed my conodonts and in February of 2003 I landed in the Brussels airport, where Pierre was so kind to pick me. But I could not find him in the crowd; I was bouncing here and there pulling my suitcase behind me. At last I found him sitting quietly on a bench and smoking his cigarillo.

Cigarillo, the inherent Pierre’s attribute, whose smell was beloved probably only by his

cat Miminke. “Mr BULTYNCK, I recognized you”, I said relieved and without much sense, and it was the start of our twenty years long familiarity, co-operation, and friendship. During this time, I learned that kindness, willingness to help, sharing knowledge were in his nature. He did not criticize, he taught. I watched how he worked, cutting carefully the photos of conodonts collected from around the world, sticking them on sheets of paper and checking the differences and similarities. We traced their FADs and LADs believing that it will come in handy for biostratigraphy. And it did. Having such extraordinary guide, my thesis acquired lustre. He came to Poland to support me during the public defense.

What else was Pierre like? Pierre was not spontaneous or exuberant, he did not get euphoric, but he appreciated such characters in other people. He appreciated our passion and devotion to the work. He was melancholic by nature, however, he was no stranger to situational humor. Once a deer visited his garden in Tildonk, romping around and gnawing trees. “Couldn’t you just catch him” I wrote in an e-mail, knowing that Pierre was a great runner in his younger age. “No” he answered, “it runs quicker than me”.

The retirement in June 2003 was not a pleasant experience for him. He decided to leave his country estate in Tildonk, where he felt lonely, and moved to vibrant Leuven. Although retirement disturbed his spiritual balance, he continued scientific work until 2016. During that time, he published another 26 papers including a few with myself. We were 1600 km apart but we saw each other quite often during conferences, during my scholarship visits and privately. We could talk on conodonts for hours. We used to visit Ardennes, the quarries, which I knew from the literature. And Pierre visited Poland, where we (me and my husband) acquainted him with our local geology. Apart from geology, we toured Belgium with its beautiful monuments, and Pierre toured Poland. He planned for us various cuisine and spiritual surprises. A nice surprise

was a sightseeing in Canada after the ICOS Conference in 2009. He persuaded Tom UYENO to go for a few-days trip, thanks to which I saw prairie and Athabasca Glacier. And there was a lot of touring across Europe.



Fig. 2. Pierre and Tom UYENO in Canada in 2009.

These wanderings always ended in good restaurants because Pierre appreciated good food, red wine and - particularly – sweets; he was the sugarbaker’s son after all. But of all wonders of the Earth, Pierre preferred all kinds of watery landscapes. In his Leuven house there was a place for a small fountain. He bought an apartment in picturesque seaside town Haan. He could then walk along the shore and meditate. In Antwerp, he liked a glassy restaurant hanging above the River Skalde, where he could contemplate its dark lazy waters. What were his thoughts about? He was a geologist, he based his studies on facts, but he was also a pupil of the catholic Saint Peter’s College in Leuven, preoccupied with religious transcendence.

I am sure that many of you knew Pierre, liked him or valued him. I tried to describe a small part of his personality from my viewpoint. He made friends forever and was very generous with friends. His home was open for us – enthusiasts of geology. But above all, he loved his family and, wherever he was, he always missed them, among them he was happy.

And then came this terrible time of pandemic closing us in homes and separating

from families and friends. This destroyed Pierre. But I am sure that he would be happy to see all his conodont compatriots and Devonian fellow workers, feeling our friendliness, like in 2013 in Morocco, when he was so proud to receive the PANDER Society Medal – the highest scientific distinction for a conodontologist.

I will miss our conversations and I am proud that you chose me as a friend, Pierre, wherever you are.

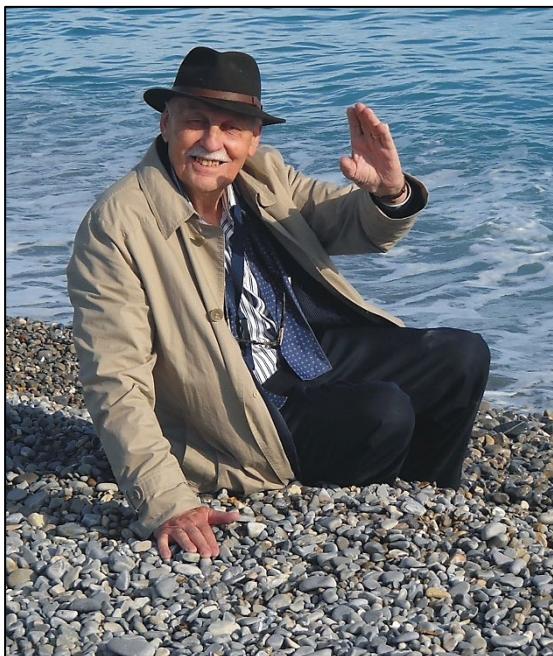


Fig. 3. Pierre greeting us from a Belgian beach.

Jörn BRINCKMANN

(13.4.1937 – 4.8.2022)

Friedrich W. LUPOLD & R. Thomas BECKER

Jörn BRINCKMANN was born in 1937 in Schwerin. After finishing school, he moved to Marburg/Lahn to study geology. In 1963 he received his Ph.D. under the supervision of C. W. KOCKEL with a dissertation on the northeastern part of the Hörre-Acker Zone near Marburg in the southeastern Rhenish Massif. Subsequently he worked on the stratigraphy and facies development of Devonian reef

limestones and associated strata in the Wuppertal-Dornap region (BRINCKMANN 1963). In 1964, he was hired by the “Bundesanstalt für Bodenforschung” in Hannover, which became later the “Bundesanstalt für Geowissenschaften und Rohstoffe”. Until his retirement in 2002, he worked there, mostly in the frame of technical cooperations with Third World countries. First, he was a “project geologist”, working with various colleagues in East Africa. For example, he conducted geological mapping in the southern highlands of Tanzania, prospected salt deposits in the Danakil Depression in Ethiopia, and used geological mapping and geochemical investigations for the exploration of ore occurrences in Uganda. In the same period, his Devonian and Lower Carboniferous results were published jointly with Peter BENDER from Marburg (BENDER & BRINCKMANN 1969).



Jörn BRINCKMANN became project leader exploring from 1972 to 1975 in Myanmar Sn ore, gem stone accumulations, and sulfidic deposits of Pb, Zn, and Ar. When he returned to Germany, he led from 1975 to 1980 a large-scale drilling program (Rhenoherzynicum-Bohrprogramm) with the aim to search for new ore deposits in the Middle Palaeozoic of the Rhenish Massif and Harz Mountains. From 1980 to 1990 he returned to Africa, where he prospected for rare earth minerals, zinc,

wolfram, and gold in Burundi. From 1990 to 1997 he led a pilot project to assess the mineral potential in Guinea, followed in 1998 to 2002 by geological mapping in the Northwest of that country. His two 1 : 100.000 maps served as the role model for the national mapping program of Guinea.

After his retirement in 2002, he devoted 12 years of joint work with the conodont specialists Dieter STOPPEL and Friedrich W. LUPOOLD to an ambitious and voluminous monograph on the Middle/Upper Devonian Brilon Reef Complex (eastern Rhenish Massif) and its overlying strata. Based on a wealth of logged and sampled boreholes and outcrops, it was meant to reflect fully the multifold results of the Rhenohercynian Program in the Brilon region. An impressive insight into this monograph was presented at one of the annual meetings of the German Devonian Subcommission. Unfortunately, the printing was delayed and delayed. In the end, both Dieter STOPPEL and Jörn BRINCKMANN deceased before the monograph is printed.

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Alan PEDDER

(30.4.1932 – 10.7.2023)

**Robert B. BLODGETT &
R. Thomas BECKER**



Fig. 1. Alan PEDDER in his Calgary office in 1987.

Alan PEDDER was born in Miri, Sarawak, the Malayan part of Borneo, where his family lived while his father was working for the Shell Oil Company. But he spent most of his youth in England, where his favourite place was St. Ives. This time was affected by the Second World War, escaping once the attack of a German war plane on a beach in Cornwall. He graduated from the University of Cambridge in 1954 and started subsequently to work as a petroleum geologist for British Petroleum (BP, 1954-1955). Then he moved to Canada, where he continued work as a petroleum geologist for the Triad Oil Company in Calgary (Alberta, 1955-1962). This was the

time of his first publications, which dealt with Devonian brachiopods (PEDDER 1959, 1960).

The next continent to be explored was Australia, where Alan became 1962-1967 a Demonstrator at the University of New England in Armidale, a small city in New South Wales, ca. half the way between Sydney and Brisbane. In this period, he published both on Canadian sections and on the Devonian of Australia, with an astonishing productivity (a dozen papers). He finished his Ph.D. at Armidale in 1968:

Subsequently, Alan returned to Canada, where he became a Research Scientist at the Geological Survey of Canada in Calgary. He stayed there until his retirement in 1995, and for many years subsequently. In parallel with his new tasks at the survey, he continued to publish on the Australian Palaeozoic. Good examples are summaries of New South Wales Devonian regions for the first International Symposium on the Devonian System that was held in 1967 in Calgary (PEDDER 1968a, 1968a). But soon the many reports on Canadian faunas took over. The scientific productivity remained extraordinary. His faunal and age data were essential to revise geological maps, especially in northern Canada regions, such as the Mackenzie River area or Arctic islands. His petroleum geology background helped enormously to communicate with company stratigraphers working on hydrocarbon exploration in Canada. The revised and refined stratigraphical schemes and ages of key lithological units (e.g. the correlation of the Nahanni Group, age of the Ogilvie Formation) had a direct impact on mapping, the interpretation of the regional structural geology, and exploration (e.g. in the case of the Horn Reef Plateau).

Alan became fast one of the few world authorities on upper Silurian and Devonian rugose corals. His expertise grew through decades of most detailed investigations resulting in an immense number of taxonomic studies (see the long publication list). He did

not only concentrate on Australian and Canadian faunas but worked also on material from various regions of the U.S. (e.g. Alaska, Nevada, California), and distant regions, such as southern Morocco (PEDDER 1999, southern France (PEDDER & FEIST 1998), the Urals (PEDDER 2019), or the Indonesian part (Irian Jaya) of Papua New Guinea (OLIVER et al. 1995). This research was based on numerous international cooperations, with a long list of partners, such as Willi NORRIS, Tom UYENO, Gil KLAPPER, Bill OLIVER, Ross MCLEAN, Jim SORAUF, Antony WRIGHT, YU Chang-Min, Raimund FEIST, Art BOUCOT, Michael HOUSE, and Robert BLODGETT, to name just a few (for more co-authors see the publication list).

Due to his expertise, he became the elected Canadian representative of the International Committee on fossil Cnidaria (1971-1976). He developed over the many years the probably most comprehensive data base for the global occurrences of Devonian corals. This became an invaluable tool for palaeobiogeographic analysis (e.g. OLIVER & PEDDER 1989; PEDDER & OLIVER 1990; PEDDER 2006). The coral data were used to contribute to the general understanding of zoogeographic provinces and Devonian plate tectonic configurations. For example, he introduced a new regional Mackenzie Province that was influenced by variable faunal immigration pulses.

Another important aspect were visiting coral workers at Calgary, e.g. on sabbatical, and his advice to several Canadian and foreign Ph.D. students. Alan reviewed regularly books and manuscripts for international journals. In addition, he advised the State Museum in Carson City, Nevada, for its exhibition on Devonian reefs. Apart from his coral work, Alan also published on several other Devonian fossil groups, such as bryozoans, brachiopods (e.g. BLODGETT et al. 2018), gastropods (PEDDER 1966a), and ammonoids (jointly with M. R. HOUSE, 1963).

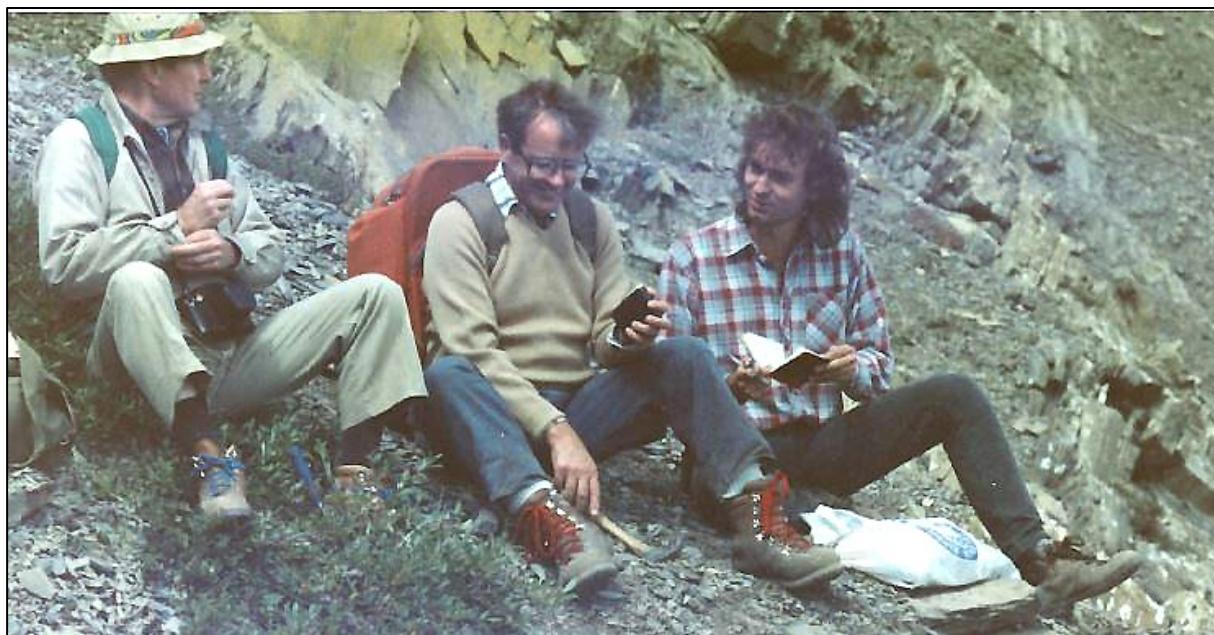


Fig. 2. Alan PEDDER during the 1987 field trip to the Canadian Rocky Mountains (after the 2nd International Devonian Symposium), between Bill OLIVER on the left and Thomas BECKER on the right.

Since his time as a petroleum geologist, Alan was a dedicated stratigrapher, whose knowledge was essential for his work at the Survey. Corals were not widely used in biostratigraphy but he showed through many studies and reviews that they were useful both regionally (e.g. PEDDER 1964b) and in relation to chronostratigraphic boundaries and global events (e.g. PEDDER 1982a; PEDDER & OLIVER 1983; OLIVER & PEDDER 1979b, 1982, 1989, 1994; SORAUF & PEDDER 1986). He had a strong emphasis on regional correlations of all benthic megafauna and with the conodont zonation (e.g. PEDDER et al. 1970a; PEDDER & KLAPPER 1977; PHILIP & PEDDER 1965, 1967a, 1967b, 1968; UYENO et al. 2017; PEDDER & GOUWY 2023). He established benthic zonal schemes for neritic sequences that were calibrated, as good as possible, with the pelagic standard based on graptolites, ammonoids, and conodonts.

With respect to his international personal background and the many contacts with other Devonian workers, it was natural to work with the International Devonian Subcommission (SDS), where he became in 1978 a Titular Member for Canada. Because of his calm,

open, clear and always friendly personality and his skills concerning structured communication, organization, data analysis, and planning, he became a perfect SDS Secretary and then SDS Chairman (1988-1992). In parallel, in 1989, he was accepted as a Corresponding Member of the IUGS Subcommission on Geochronology. Alan was also a member of the Devonian-Carboniferous Boundary Working Group.

His reputation earned him other duties, such as the invitation to chair an “International Symposium on the Devonian System and its Economic Oil and Mineral Resources” in Guilin, Guangxi, South China in 1992. The field trip associated with this meeting enabled SDS Members the first-time access to Devonian successions that had rarely or never been visited by non-Chinese workers. It felt like an alien invasion, when the excursion passed through the then very rural village of Nanbiancun and its ponds with water buffaloes, on the way to the Chinese Auxiliary Stratotype for the Devonian-Carboniferous boundary. In one of the cities, a Hongkong business man had been robbed in the only suitable hotel, so that all the excursion party

was driven to an army camp to stay in the safe officer's rooms. But the army hospitality was great and there was no shortage of rice wine.

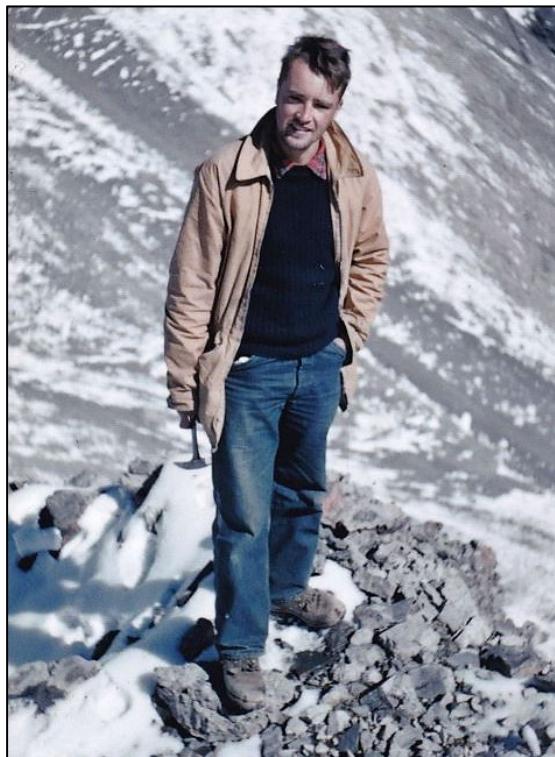


Fig. 3. Alan PEDDER in the field around 1959.

Alan was a real field geologist that enjoyed logging and collecting in partly remote regions, or during the excursions associated with the international meetings that he attended, e.g. the ones involving SDS. A great anecdotal story regarding Alan is on his return from field work in the Canadian Arctic in the early 1960's back, when he was employed in the oil industry. He and a field associate had just arrived in Edmonton and were looking like a bunch of unshaven vagabonds in the downtown area. The police were following him and his colleague around and apparently cornered them and asked them to produce evidence that they were who they claimed to be, not a bunch of ruffians. Anyone who knew Alan could not imagine him looking this way, but such is life when you just come out of the field.

Alan assembled an important collection of material from the various Canadian study regions, Nevada, Iowa, Great Britain, Belgium, southern France, Germany, and Australia.

Stromatoporoids, sponges, trilobites, and conodonts were given to specialists for investigation and publication. We have not counted the high number of families, genera, and species introduced by him. His taxonomic publications include the highest quality of photo documentations.

After retirement, the Alan's research productivity continued. In the period since 1996, he (co-)authored 17 additional papers, partly on non-Canadian faunas. He continued research in his home in the town of Sydney on Vancouver Island (British Columbia) right until his passing away – before the last publication came out together with Sofie GOUWY, who followed Tom UYENO in Calgary as the conodont specialist.



Fig. 4. Alan PEDDER working at home in 2022.

Alan met and married his wife, Lou MCBRIDE, in Calgary, Alberta (1959). Alan is survived by his wife Lou and his son Richard and daughters Pamela and Lindsay (all children born in Australia). With him, the international community of coral and Devonian workers lost an outstanding scientist, whose richness of published work ensures that his contributions will not be forgotten as long as anybody studies

Devonian corals and biostratigraphy, not only in Canada. But more important is the loss of an extremely honest, friendly, humorous, helpful and thoughtful personality that was liked by anybody that had the pleasure to meet him, to join him in the field, or to work with him.

Taxa named after Alan PEDDER

- Cassidirostrum pedderi* McLAREN, 1961 [Middle Devonian rhynchonellid brachiopod]
Ponticeras pedderi HOUSE, 1963 [upper Frasnian goniatite, species of "Stilleoceras"]
Eostrophalosia pedderi CRICKMAY, 1963 [lower Frasnian brachiopod]
Franklinella pedderi LENZ, 1973 [Lochkovian rhynchonellid brachiopod]
Pelekysgnathus pedderi UYENO & MASON, 1975 [Eifelian conodont, species of *Streptotaxis*]
Taimyrophyllum pedderi Zhen, 1995 [Emsian rugose coral]
Yukonoconcha pedderi FRÝDA, BLODGETT & LENZ, 2002 [Pragian gastropod]
Thamnophyllum pedderi MCLEAN, 2005 [Frasnian rugose coral]
Stauromatidium pedderi ERINA, 2007 [Pragian rugose coral from Uzbekistan]

Acknowledgements

This obituary benefitted enormously from files and photos supplied by Alan's wife, Lou PEDDER. We also like to acknowledge Francisco Javier CUEN ROMERO (Sonora University, Mexico), who co-authored with Robert BLODGETT two shorter obituaries for journals in Alaska and Mexico.

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Luca SIMONETTO

(25.1.1964-12.2.2023)

**Carlo CORRADINI, Maria G. CORRIGA,
Erika KIDO, Monica PONDRELLI, Thomas
J. SUTTNER & Claudia SPALLETTA**



Fig. 1. Luca SIMONETTO at the summit of Mt. Zermula, one of the main Devonian reefs of the Carnic Alps.

Luca SIMONETTO was the responsible of the Geological and Palaeontological collection of the Friulian Natural History Museum in Udine, north-east Italy.

He was passionate in geology and palaeontology, mainly of the Carnic Alps, and more in general of Friuli, his native region. Already as a high school student, due to his passion for geology and palaeontology, he got in touch with the Friulian Museum of Natural History, collaborating in the organization of exhibitions. Later, as an external collaborator, he took care of the revision and reorganization of palaeontological collections, and he continued his activity when he got a position as a technician of the Museum. The result of his dedication is that now the geological and palaeontological collection includes more than 130.000 specimens organized according to the most modern criteria.

The activity of managing this collection often brought him into contact with specialists from all over the world interested in Friulian

fossils and geology. However, his activity was not limited to simple support. He was actively involved in research lines developed by Italian and foreign universities and institutions: among many others, those interested in the Palaeozoic Sequence of the Carnic Alps (Universities of Bologna, Modena and Reggio Emilia, Cagliari, Trieste and Graz, the Austrian Geological Service, the Natural History Museum of Bozen, etc.).



Fig. 2. Luca during the preparation of the exposition on the Devonian reefs of the Carnic Alps (Tolmezzo, UD, 2016).

He spent several weeks in the field with colleagues and friends, and during field research, he never missed an opportunity to collect material in order to enrich the museum's collections. He was an active member of the Working Group, which redefined the lithostratigraphy of the Pre-Variscan sequence of the Carnic Alps (2008-2015). Also, he was involved in the organization of several international meetings, congresses, and field trips. Among those, the IGCP 596 final meeting (Udine, 2016), "Geological research in the Carnic Alps – from past to future" (Udine 2019), and the field trips in the Carnic Alps connected to the IGCP 580, 4th Annual meeting (Graz 2012), 4th International Conodont Symposium (Valencia, 2017), and the 13th International Symposium on Fossil Cnidaria and Porifera (Modena 2019).

Luca SIMONETTO is (co-)author of about 100 papers, mainly devoted to the geology and palaeontology of Friuli, mainly of the Carnic

Alps. Among these, several addressed Devonian topics. Despite his huge knowledge and strong professionalism, Luca will be remembered and missed especially because of his humanity and kindness, his friendship, hospitality (his house was always open to everybody for sharing a beer or a meal) and a fine sense of humour.



Fig. 3. Maria G. CORRIGA, Luca SIMONETTO, Thomas J. SUTTNER, Erika KIDO, and Monica PONDRELLI (from left front to right) at Cason di Lanza Hut during the 2010 field campaign in the Carnic Alps.

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overloading after a long pandemic break, working groups went on with their work on revision of the GSSPs (the basal Emsian and the Devonian-Carboniferous boundary). Due to the “back to normal”, several organized meetings and fieldworks enabled that SDS members started to meet face to face again. The small subprojects that have been launched in 2020, focussed on the gathering of data around the problematic GSSPs, were partly accomplished last year. In 2022 a load of work has been done in the Prague Synform, Spanish Central Pyrenees, and Morocco concerning the Basal Emsian Boundary. The major issues were discussed during the Annual Business Meeting of the SDS that took place in November 8th in Khon Kaen, Thailand, in conjunction with the 6th International Palaeontological Congress. It was the first SDS non-virtual meeting since Milano 2019. The next, regular Annual SDS Business Meeting will take place next year in Geneseo, New York State, during the Devonian oriented conference and fieldtrips. Other SDS activities included the organisation of a Devonian session at the IPC, the planning of future Devonian symposia, and the publication of the SDS Newsletter that includes all major Devonian-related topics. Also, a monographic journal volume on the Rhenish Massif of Germany has been published.

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

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

SDS REPORTS

Annual Report to ICS

1. TITLE OF CONSTITUENT BODY

Subcommission on Devonian Stratigraphy

Reporting Ladislav SLAVÍK (Chair)

2. OVERALL OBJECTIVES AND FIT WITHIN IUGS SCIENCE POLICY

Restrictive pandemic measures in most countries were lifted in 2022 and thus numerous activities of the SDS continued in a normal way. In spite of some difficulties, e.g., with delayed laboratory works due to their

3. ORGANISATION - interface with other international projects/groups

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

3a. Current Officers for 2020-2024 period:

Chair: Ladislav (Lada) SLAVÍK

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

Secretary: Ulrich (Uli) JANSEN

Webperson: Carlo CORRADINI

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

The University of Münster continues to support the staff costs of the SDS Newsletter production and the mailing. The IUGS support pays for the printing. The Newsletter has an ISSN and status as a publication. Since last year it is published and printed partly in colour; a pdf version is published on the SDS web page.

We have regular annual meetings (this year face to face again). SDS members support their own attendance at these.

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

5. CHIEF ACCOMPLISHMENTS IN 2022 (including any publications arising from ICS working groups)

- The **Annual business meeting of the SDS** took place in November 8th in Khon Kaen, Thailand, in conjunction with the 6th International Palaeontological Congress. It was the first SDS non-virtual meeting since Milano 2019, and, in spite of a long break in personal meetings, it was relatively well attended. The CHAIR and VICE-CHAIR informed about major points in the business meeting agenda and the current situation in our Devonian community, on-going Devonian projects (reports on biostratigraphical, petrophysical and geochemical data from the key areas and

progress in the Basal Emsian boundary redefinition), Devonian publications, and forthcoming meetings. We had 17 participants including guests from 9 countries. The meeting was successful: we recruited three new Corresponding Members from Thailand, Mongolia, and Algeria. These countries are thus newly represented within the SDS community.

- **Update of the new SDS webpage** – housed on the ICS web (stratigraphy.org)
- **Publications:** SDS Newsletter No. 37 (with 85 pp.) and a special volume of *Palaeobiodiversity and Palaeoenvironments* “The Rhenish Massif: More than 150 years of research in a Variscan mountain chain” (Guest-editors: CMs S. HARTENFELS, C. HARTKOPF-FRÖDER & P. KÖNIGSHOF), with 11 contributions on 336 pages.

6. SUMMARY OF EXPENDITURE IN 2022 (in US \$):

SDS Newsletter	750
International Palaeontological Congress (IPC6) and SDS meeting - travel costs:	
SDS Chair	900
SDS Vice-Chair	900
CM Ariuntogos MUNKHJARGAL (special travel grant, Key Note in Dev. session)	500
SDS Secretary (Smithsonian Museum Washington D.C. - brachiopod study)	900

7. SUMMARY OF INCOME IN 2022:

ICS support:	4.000 US \$
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8. BUDGET REQUESTED FROM ICS IN 2023

The long planned SDS and IGCP 652 - Annual Meeting and field-based conference in Geneseo, New York State, USA, will take place from 26 July 2023 to 07 August 2023. The SDS will have a regular SDS business meeting there, including Devonian focused sessions. Our main focus will be the redefinition of the base Emsian GSSP (we expect specific proposals) and a meeting to discuss the D-C boundary for redefinition of the base of the Carboniferous.

For the next year, there is also another possibility to meet: STRATI in Lille, France, 11-13 July 2023. The SDS has proposed a Devonian session: *Devonian paleoenvironments and time*. The convenors would be the SDS officers (Ladislav SLAVÍK, José Ignacio VALENZUELA-RÍOS, and Ulrich JANSEN). We request contributions to travel costs for both of these meetings.

SDS Chair travel costs	\$950
SDS Vice-Chair travel costs	\$950
SDS Secretary travel costs	\$950

In addition, we request part support for production of the SDS Newsletter \$750
Total Sum requested from IUGS \$3.600

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

- Work on formal proposals or progress reports submitted from key areas for the revision of the basal Emsian GSSP.
- Revision of the D/C boundary with the D/C Boundary Task Group in close collaboration with the Carboniferous Subcommission. Progress towards selection of stratotype candidates.
- Real SDS business meeting and Devonian symposia

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

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

APPENDIX: Names and Addresses of Current Officers and Voting Members

NOMINATED OFFICERS

CHAIR

Ladislav SLAVÍK, Department of Paleobiology and Paleoecology, Institute of Geology of the Czech Academy of Sciences, Rozvojová 269, CZ-165

02 Praha 6, Czech Republic, Tel.: 00420 233087247; slavik@gli.cas.cz

VICE-CHAIR

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

SECRETARY

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

SDS NEWSLETTER EDITOR

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

WEBMASTER

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

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

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

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

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

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

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- 59655 Villeneuve d'Ascq, France, Tel.: 33 (0)3-20-43-41-51, e-mail: catherine.cronier@univ-lille1.fr; trilobites
- A-C. Da SILVA, Pétrologie sédimentaire, B20, Allée du Six Août, 12, Quartier Agora, Université de Liège, 4000 Liège, Belgium, Tel.: +32 – 43662258, e-mail: ac.dasilva@ulg.ac.be; astrochronology;
- Y. GATOVSKY, Moscow State University, Dept. of Paleontology, Geological Faculty, Vorob'evy Gory, 1, Moscow, GSP-1, 119991, Russia, Tel.: 007 495 9394960, e-mail: gatovsky@geol.msu.ru; conodonts
- N. G. IZOKH, Institute of Petroleum Geology and Geophysics, Siberian branch of Russian Academy of Sciences, Acad. Koptyug. Av. 3, 630090 Novosibirsk, Russia, Tel.: + 7 (383) 333-24-31, e-mail: IzokhNG@ipgg.nsc.ru; Russia, conodonts
- X.-P. MA, Peking University, Department of Geology, Beijing 100871, China, e-mail: maxp@pku.edu.cn; brachiopods
- J. E. A. MARSHALL, School of Ocean and Earth Science, University of Southampton, National Oceanography Centre, European Way, Southampton SO14 3 ZH, UK, Tel.: +44-23-80592015, e-mail: jeam@noc.soton.ac.uk, plants
- D. J. OVER, SUNY Geneseo, Department of Geological Sciences, Geneseo 14454 N.Y., U.S.A., Tel.: +1-585-24552945291, e-mail: over@geneseo.edu; conodonts
- W.-K. QIE, CAS Key Laboratory of Economic Stratigraphy and Palaeogeography, Nanjing Institute of Geology and Palaeontology and Center for Excellence in Life and Paleoenvironment, Chinese Academy of Sciences, Nanjing 210008, China, e-mail: wkqie@nigpas.ac.cn; chemostratigraphy
- G. RACKI, University of Silesia, Faculty of Earth Sciences, Department of Palaeontology and Stratigraphy, Będzińska str. 60, 41-200 Sosnowiec, Poland, Tel.: 48-32-3689-229, e-mail: racki@us.edu.pl; brachiopods, event & sequence stratigraphy
- C. SPALLETTA, Dipartimento di Scienze della Terra e Geologica Ambientali, Università di Bologna, I-40126 Bologna, Italy, Tel.: +39-051-2094578, e-mail: claudia.spalletta@unibo.it; conodonts
- K. TRINAJSTIC, Faculty of Science and Engineering, School of Science, Department of Environment and Agriculture, Bentley Campus 311.117, Australia, Tel.: Phone: +618 9266 2492, e-mail: kate.trinajstic@uwa.edu.au; fish

List of Working (Task) Groups and their officers

Emsian Working Group (EWG)

The Emsian Working group has been recently re-established (2021) in order to solve the problems with the correlation of the basal Emsian boundary. The members are expected to present and evaluate proposals for the basal Emsian GSSP redefinition. The Working group is open to other specialists involved in this task.

Members

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

Devonian/Carboniferous Boundary Task Group (DCB TG)

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

Members

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

Minutes of the Annual SDS Business Meeting 2021 (via ZOOM)

October, 19, 2021, Prague, Czech Republic

Uli JANSEN, Ladislav SLAVÍK & José Ignacio VALENZUELA-RÍOS

Attendance

The Chairman (L. SLAVÍK), Vice-Chairman (J. I. VALENZUELA-RÍOS), Secretary (U. JANSEN).

TMs: R. T. BECKER, C. E. BRETT, C. CORRADINI, X. MA, J. E. A. MARSHALL, D.J. OVER, W. QIE, A.-C. DA SILVA, C. SPALETTA.

CMs: Z. S. ABOUSSALAM, G. BAIRD, I. EVDOKIMOVA, J. L. GARCÍA-ALCALDE, M. GINTER, S. HARTENFELS, A. HUŠKOVÁ, J.-C. LIAO, E. LUKŠEVIČS, A. NAZIK, S. NIKOLAYEVA, M. DI PASQUO, L. PONCIANO, E. SCHINDLER, T. SUTTNER, C. VER STRAETEN, J. J. ZAMBITO.

Guests: Hedvika WEINEROVÁ, Tomáš WEINER.

Apologies for non-attendance had been received from: TM R. BROCKE, CM C. J. BURROW, CM S. TURNER, CM S. VODRÁŽKOVÁ.

Total attendance: 31 people.

The business meeting started at 17.00 Central European Summer Time (CEST).

1. Introduction

Chairman Ladislav SLAVÍK welcomed the audience. He introduced himself as SDS Chair, then Vice-Chair José Ignacio VALENZUELA-RÍOS, Secretary Ulrich JANSEN, Newsletter Editor R. Thomas BECKER, and SDS Webmaster Carlo CORRADINI.

The CHAIRMAN reported that no SDS members or internationally known Devonian workers passed away this year. The obituaries of the outstanding Devonian workers and friends Peter CARLS, Bruno MISTIAEN and Vladimir KHROMYKH were published in the SDS Newsletter 35.

2. Formal approval of 2019 minutes

The CHAIRMAN Asked if there were comments on the minutes of the SDS Meeting in Milano 2019. There were none, and the Minutes of 2019 were formally approved. They have been edited already and appeared in the SDS Newsletter 34.

3. Chairman's Business

The CHAIRMAN reported that several stratotypes and stratigraphic rules were approved in 2021:

A) Approval of the GSSP of the Kimmeridgian Stage (Jurassic) in the foreshore at Flodigarry, Staffin Bay on the Isle of Skye (Scotland).

B) Approval of the inclusion of subseries/subepochs as formal chronostratigraphic/geochronologic units in a new/revised version of the International Stratigraphic Guide, when published. Individual subcommissions will not be obliged to define these units for their systems/periods unless they consider it appropriate to do so.

C) Ratification of the Neogene subseries/subepochs as units of formal rank to be included in the International Chronostratigraphical Chart as follows: the Lower/Early Miocene (comprising the Aquitanian and Burdigalian stages/ages), Middle Miocene (comprising the Serravallian and Langhian stages/ages), Upper/Late

Miocene (comprising the Tortonian and Messinian stages/ages), Lower/Early Pliocene (corresponding to the Zanclean Stage/Age) and Upper/Late Pliocene (corresponding to the Piacenzian Stage).

D) Approval of the Global Boundary Stratotype Section and Point (GSSP) of the Coniacian Stage/Age (Cretaceous) in the Salzgitter-Salder Quarry section in Lower Saxony, Germany.

E) Announcements of the ratified GSSPs for the Hauterivian (Cretaceous) and Priabonian (Paleogene) have been published.

Detailed information on these new decisions can be found on the ICS webpage (<https://stratigraphy.org/>). These changes are to be applied to the new issue of the International Chronostratigraphic Chart.

4. ICS Matters

The CHAIRMAN was asked by Stan FINNEY to provide bullet points of principal highlights and key achievements during the past period of 18 months for a report to the IUGS. He sent several highlight points to foster his presentation. There will be a video meeting of the ICS, but the date has not yet been specified.

5. Revision of the Pragian/Emsian boundary, discussion on possible solutions

The CHAIRMAN reported that the problem of the Pragian-Emsian boundary remained unsettled owing to the scarcity of polygnathid conodonts at the envisaged approximate level of a revised boundary definition in the Zinzilban section (Uzbekistan). During the SDS meeting in Milano, it was said that at least two proposals for possible new boundary stratotypes, either in the Prague Synform or in the Pyrenees, can be expected. Any proposal from Uzbekistan (Kitab State Geological Reserve) would also be welcome. Due to the unfavourable situation, the progress has been delayed, but the CHAIRMAN expressed his hope that the proposals could be presented within the next few years.

There are several on-going projects focused on the Pragian-Emsian boundary with partial support from the SDS, because, following the SDS decision, alternative proposals to the current basal Emsian stratotype are to be made:

A) Prague Synform

In autumn 2020, the CHAIRMAN started a new project focused on the gathering of new geophysical, geochemical and biostratigraphical data from the Praha Formation that had represented the original Pragian Stage before the current GSSP was defined. The project is partly supported by the SDS budget but mostly by the Czech Science Foundation. In the initial stage, the focus was put on several sections (potential candidates). At present, sampling for geochemical proxies using isotope studies and Instrumental Neutron Activation Analysis (INAA) is completed, the sampling for microfacies study is almost finished, and sampling for biostratigraphy and macrofauna is under way. At the same time, Gamma-Ray Spectrometry (GRS) and magnetic susceptibility (MS) logging is in progress. The team also consists of Jindra HLADIL, Tomáš WEINER, and Hedvika WEINEROVÁ from Prague.

B) Pyrenees

The ICS executive received additional funding from the IUGS for ‘special sub-projects’ within the project ‘Regenerating the Time Lords: Towards the completion, calibration, digitization and outreach of the geological timescale’. An application for an ICS special grant in order to obtain mainly geochemical data from Pragian–Emsian sections of the Spanish Central Pyrenees was successful, and TM J. I. VALENZUELA-RÍOS was awarded special ICS funds.

C) Rhenish Massif

TM U. JANSEN studied Pragian/Emsian brachiopod biostratigraphy in the Eifel region (Germany) and its international correlation. Field work in selected sections exposing the Saxler and Eckfeld formations was carried out

to study the biostratigraphic content around the traditional Emsian base in the Rhenish Massif.

D) Morocco

TM R.T. BECKER, the Münster working group and colleagues investigated Pragian-Emsian boundary sections in the Devonian of Morocco: The upper Pragian und lower Emsian of the Anti-Atlas (Tafilalt and Dra Valley) has been intensively studied by CM Z. S. ABOUSSALAM et al. (2015). *Polygnathus excavatus* ssp. 114 is present there, but very few conodonts below its level. During recent years it has been shown that variably neritic or pelagic nodular limestone successions occur also in several parts of the Moroccan Meseta (BECKER et al., eds., 2020, 2021). These have previously been very sparsely or not sampled at all for conodonts and microfacies. Relevant sections are known from the Tiflet region (Tiflet Quarry), Ben Slimane, Benahmed region, from around Azrou (Bou Ighial, Bab-el-Ari), at Jebel ben Arab, Skoura region, and in the Mrirt region. New fieldwork of the Münster group in the Moroccan Meseta benefited from the SDS support.

Summing up, it can be said that work is in progress, and proposals of possible candidates and/or presentation of relevant sections can be expected within the next two or three years, from some regions may be even earlier. The projects are supported by only small amounts from the SDS budget (i.e. hundreds of euros), with exception of the project in the Pyrenees (5.000 US \$ support) but in any case, these must be supported mainly from other sources.

6. Information about progress in D/C boundary redefinition

The CHAIRMAN noted that DCB Task Group leader Markus ARETZ apologized that he was in the field and asked TMs Carlo CORRADINI and Thomas BECKER to comment on the recent development of the D-C boundary studies.

C. CORRADINI: A correlation chart including many new data including isotope

peaks around the D-C boundary is presently prepared. It is needed to define series above and below the D-C boundary, and this can be applied to define the boundary. Next year they expect to submit a proposal to the ICS for approval and look for a new GSSP.

The CHAIRMAN: A small SDS subproject was conducted by TM R.T. BECKER and collaborators on a potential Devonian-Carboniferous GSSP candidate at Borkewehr (northern Rhenish Slate Mountains).

TM R.T. BECKER: The SDS support has been used to finance field work (in cooperation with CM S. HARTENFELS and D. WEYER, BERLIN) in the Höhne Valley region, including new sampling at Borkewehr and at the famous first D/C boundary stratotype in the Oberrödinghausen railway cut. In addition, it was used for conodont sampling processing in the Münster conodont lab. This enabled in summer 2021 the completion of a multi-authored and multi-disciplinary manuscript on the Borkewehr section, which was submitted to *Palaeobiodiversity and Palaeoenvironments* (current status “corrected after revision” [fully published in 2022]).

7. Devonian substages

The Chairman pointed out that the Devonian substages will not be tackled before formally approved by the ICS, and substages cannot be officially defined before all stage boundary stratotypes are agreed upon.

8. SDS Membership

Proposals of new CMs:

Markus ARETZ (proposed by the CHAIRMAN and TM C. CORRADINI) – corals, foraminifers, DCB boundary

Hedvika WEINEROVÁ (proposed by the CHAIRMAN) – Devonian sedimentology, isotope studies, micro- and macrofauna;

Tomáš WEINER (proposed by the CHAIRMAN) – Devonian micro- and macrofauna, various palaeoenvironmental proxies such as MS, GRS, etc.;

Till SÖTE (proposed by TM R. T. BECKER) – ammonoids;

Felix LÜDDECKE (proposed by TM R. T. BECKER) – upper Frasnian substages, conodonts;

Jianfeng LU (proposed by TM J. I. VALENZUELA-RÍOS and CM J.-C. LIAO) – conodonts;

The chairman encouraged the members to keep on with proposing new SDS members (new CMs and TMs).

9. New Devonian Webpage

The Chairman reported that the new SDS webpage had been launched on the ICS webpage. He thanked C. CORRADINI (SDS webmaster) and Nick CARR (ICS webmaster) for producing it, praised its clear arrangement and underlined the advantages of its embedding within the ICS content.

10. SDS Devonian Publications

The chairman pointed to several important Devonian-related volumes:

1) Special volume of *Palaeobiodiversity and Palaeoenvironments* (101, 2): “**Global Review of the Devonian-Carboniferous Boundary**” (Guest-editors: CM M. ARETZ & TM C. CORRADINI), published in June 2021, with 15 contributions on 370 pages;

2) Special volume of the *Scientific Journal of the Hassan II Academy of Science and Technology*: “**Devonian to Lower Carboniferous stratigraphy and facies of the Western Moroccan Meseta: Implications for palaeogeography and structural interpretation**” (Guest-editors: TM R. T. BECKER, CM A. EL HASSANI & CM Z. S. ABOUSSALAM), with 194 pages [open access].

3) *Geological Time Scale 2020* (GRADSTEIN et al., eds., 2020, two volumes). The Devonian chapter was compiled by TM R. T. BECKER, J. E. A. MARSHALL, and A.-C. DA SILVA.

4) CM C. VER STRAETEN announced a *Devonian volume of New York* (min. 2 vols. with 12 chapters), which is planned to be published in spring 2022. As well, the field trip

guidebook of the 1997 SDS Meeting will be available online.

5) CM S. HARTENFELS reported on a forthcoming Devonian volume on the Rhenish Massif (CMs HARTENFELS, S., HARTKOPF-FRÖDER, C. et al., eds., Special Issue “Devonian and Mississippian of the Ardenno-Rhenish Massif”. *Palaeobiodiversity and Palaeoenvironments*).

6) TM R.T. BECKER informed on a volume on the Central European Variscides by Ulf LINNEMANN (ed.), with more than 30 announced contributions including Devonian topics (Springer).

In addition, many Devonian-related papers were published by the Devonian community; these are reported in the present issue of the SDS Newsletter.

11. Future Meetings

The chairman pointed to the uncertainties concerning future meetings and expressed his hope that real-life meetings will be possible again soon:

1) The next International Palaeontological Congress (IPC6) shall take place in November 2022 in Khon Kaen, Thailand. SDS (CM Peter KÖNIGSHOF and others) has proposed a Devonian symposium entitled “*Devonian palaeoenvironments and mass extinctions*”.

2) The bi-annual conference and field meeting of the Silurian Subcommission (ISS) is planned for Summer 2022 in Bulgaria; there are Silurian and Devonian sections to be visited (organized by Valeri SACHANSKI).

3) The planned SDS meeting and field trip to New York State by TM Jeff OVER and co-organizers has been postponed to 2023. TM J. OVER noted that he meeting and fieldtrips are planned for the last week of July and first week of August 2023.

4) CM M. ARETZ invited the SDS members to join the next Carboniferous-Permian Congress in Toulouse in July 2023 [subsequently postponed]. The CHAIRMAN encouraged the

SDS Members to participate in this meeting, whose scope will be extended downwards to the Devonian. The idea is to offer different communities working on Devonian-Permian subjects an opportunity to meet. Also, colleagues working, for example, on geodynamics, structural geology, etc. of the Variscan Chain should be present. Every community present will have the opportunity to organise its own session.

The CHAIRMAN: There is no information yet about the already twice postponed 36th International Geological Congress.

TM R. T. BECKER asked about the ICOS Meeting in China which is planned for 2022. TM Wenkun QIE and the CHAIRMAN: There is at present no information.

The CHAIRMAN asked about the GSA meeting that has just been held. TM J. OVER informed about combined organizational and technical problems in the Devonian session.

CM Mercedes DI PASQUO informed about two forthcoming meetings in South America:

1) In the framework of the “27th Brazilian Congress of Paleontology 2022” that will be held in the city of Cuiabá, Brazil, the 1st Gondwana Devonian Symposium will take place on May 5th. The symposium will focus on “Calibrating the Devonian in South America” and will include lectures about the Devonian of Gondwana. All researchers interested to participate are invited to send contributions in order to increase the knowledge about the Devonian of the Southern Hemisphere. In addition, the Devonian of South Africa and Australia will be addressed in lectures given by specialists. Event website: <https://sites.google.com/view/1stgds/home?authuser=02>)

On behalf of the “Asociación Latinoamericana de Paleobotánica y Palinología (ALPP)”, CM M. di PASQUO, as its president, supports the organization of the XVII Simposio Argentino de Paleobotánica y Palinología, which will be held at San

Salvador de Jujuy city (Jujuy province, Argentina) in November 2022. More information will be provided soon on the ALPP website

12. Financial Report

The CHAIRMAN presented the financial report. In 2021, the SDS received 3.000 US \$, still more than in most previous years. The support is spent for the production of the SDS Newsletter and the small SDS subprojects launched last year and focused mostly on the basal Emsian and D-C boundaries. Due to the present situation, just work on the most important topics within the home countries was possible. There will be a small balance from the last year.

13. Any other business

TM R. T. BECKER: the next SDS Newsletter is in production.

The CHAIRMAN: SDS plans to grant an award to young researchers for excellence in research as it has been practised in some other subcommissions. Next year the award should be offered for the first time. The award would include a diploma + amount of ca 300 to 500 US \$, depending on the available funds. The CHAIRMAN asked the audience, who would be willing to participate in the SDS award committee to process the award competition. This issue will have to be settled during next year. Everyone will be asked for nominations for the award.

E. SCHINDLER informed about his retirement in 2022, but he will continue his work on tentaculitoids.

The CHAIRMAN expressed his thanks to the audience for participation at the meeting and for all Devonian-related activities.

The meeting ended at 6:15 p.m. Central European Summer Time (CEST)

Minutes of the Annual SDS Business Meeting 2022, Khon Kaen, Thailand

Pullman Khon Kaen Raja Orchid Hotel, Iyara Room, November 8th, 9:01 to 10:20 am

José Ignacio VALENZUELA-RÍOS & Ladislav SLAVÍK

Participants:

The CHAIRMAN (Ladislav SLAVÍK), the VICE-CHAIRMAN (Nacho VALENZUELA-RÍOS).

TMs: Thomas BECKER (SDS Newsletter editor), John E. A. MARSHALL, Kate TRINAJSTIC.

CMs: Jau-Chyn LIAO (Teresa), Peter KÖNIGSHOF, Till SÖTE; On-line: Catherine GIRARD and Jianfeng LU.

Guests: ICS Chairman (David HARPER), Mieke LÖW, Ariuntogos MUNKHJARGAL, Mongkol UDCACHON, Hathaithip THASSANAPAK, WANG YI, and RENBIN ZHAN.

Total attendance: 17 people.



Fig. 1. The CHAIRMAN and VICE-CHAIRMAN leading the SDS Business Meeting at Khon Kaen, Thailand.

Apologies for non-attendance:

The Secretary (TM Uli JANSEN), TMs Carl BRETT and Claudia SPALLETTA, CMs Chuck VERSTRAETEN, Eberhard SCHINDLER, Jay ZAMBITO, Sarah ABOUSSALAM, Felix SAUPE, Sven HARTENFELS, Ervins LUKSEVICS, and James EBERT.

The meeting followed the agenda distributed earlier per e-mail.

1. Introduction

The CHAIRMAN welcomed the audience to the first face-to-face meeting after COVID-19. He expressed his special thanks to David HARPER and the ICS for supporting the Devonian activities. After mentioning the apologies for non-attendance (see above), he introduced the SDS officers. Thanks were also expressed to Mongkol UDCACHON for the organization of the IPC and the fieldtrip.

TM Thomas BECKER reported the passing of Jörn BRINCKMANN, a German specialist on Devonian reefs and mineral deposits [see obituary in this issue]), and TM John MARSHALL the passing of former TM John B. RICHARDSON (London), one of SDS's specialists on Devonian spores.

The audience held a minute of silence for all Devonian workers, who passed away in the last two years.

2. Minutes of 2021 Meeting

The CHAIRMAN apologized for forgetting to include the minutes of the last annual business meeting in the SDS Newsletter. Nevertheless, they have been sent via bulk e-mail to the SDS members. The minutes from the SDS 2021 ZOOM meeting were formally approved; they will be published in the 2023 Newsletter.

3. Chairman's Business – New GSSPs approved by ICS

The CHAIRMAN reported on ICS activities and the approval of new GSSPs:

- Approval of the Global Boundary Stratotype Section and Point (GSSP) of the Artinskian Stage/Age (Cisuralian Series/Epoch, Permian System/Period) in the Dal'ny Tulkas section, southern Urals, in Russia. The GSSP is proposed at the point indicated by the FAD of *Sweetognathus asymmetricus* at 0.6 m above the base of Bed 4b in the Dal'ny Tulkas section. An interpolated geochronological age of between 290.1 Ma ± 0.2 Ma and 290.5 Ma ± 0.4 Ma, strontium isotope values near 0.70767, and many additional fossils groups, particularly ammonoids and fusulinides,

serve as additional markers for the identification and correlation of the boundary.

- Approval of the Global Boundary Stratotype Section and Point (GSSP) of the Campanian Stage. The GSSP is the magnetic polarity reversal from Chron 34n (the top of the Long Cretaceous Normal Polarity Chron) to Chron C33r at the 221.53 m level in the Bottaccione Gorge section at Gubbio, Umbria-Marche Basin, Italy.
- Approval of the age of $4.567.30 \pm 0.16$ Ma for the lower boundary of the Hadean Eon. This Global Standard Stratigraphic Age (GSSA) represents a chronological reference point numerical date used to define the basal boundary of the Eon. This numerical age is derived from the weighted mean U-corrected Pb–Pb age for calcium-aluminium inclusions in primitive meteorites. The suggestion for the lower boundary of the Hadean Eon is the age of the Solar System based on the oldest solid CAIs in the protoplanetary disc. This $4.567.30 \pm 0.16$ Ma age date is supported by the 4.568–4.567 Ma U-corrected Pb–Pb ages of chondrules found in Northwest African meteorites. These dates set an upper lifetime for the protoplanetary disc and timing of planet formation.
- Approval of the International Subcommission on Stratigraphic Classification (ISSC) proposal for formal recognition of Standard Auxiliary Boundary Stratotypes: a proposed replacement for the Auxiliary Stratotype Point in supporting a Global Boundary Stratotype Section and Point (GSSP).
- The Chairman commented that the auxiliary stratotype points are necessary because some stratotypes became obscured or destroyed. For instance, the monument at Klonk is fenced and the Bed 20 almost gone due to intense samplings. A good reference for the S-D boundary is the auxiliary stratotype at Budňany rock near Karlštejn.

4. ICS Matters — ICS business ZOOM meeting February 25th

The last ICS business meeting was attended by the VICE-CHAIRMAN (via Zoom). Each subcommission representative presented a short report on GSSPs that are in progress and are nearing completion together with other activities planned in the coming year. Website and information developments followed, also the ICS contributions to the IUGS 60th anniversary celebrations and Deep-time Digital Earth (DDE).

The location of STRATI 2023 has been decided [at Lille, France].

5. Information about work on GSSP alternatives – progress reports

- Regarding work on GSSPs, the CHAIRMAN summarized the **Pragian/Emsian** issue and reported on the progress in the upper part of the Praha Formation with the Bohemian Graptolite Event as the critical interval for the prospective base of the Lower Emsian.
- TM Thomas BECKER reported that the Graptolite Event can be correlated in the Anti-Atlas (Morocco), where it is represented by black shales but no graptolites occur.
- TM Nacho VALENZUELA-RÍOS explained the progress in the Pyrenees, where last summer a fieldwork campaign was devoted to paleomagnetic and magnetic susceptibility sampling in two candidate sections (Isábena-1 and Baliera-6, the latter was visited by SDS members during the ICOS IV fieldtrip). Also, chips from cores were processed for geochemical analysis.
- The CHAIRMAN briefly explained the problems of the P/E boundary in Uzbekistan.
- TM Thomas BECKER indicated that the sampled sections in the Meseta are full of icriodids. He asked if the samples in which CM JIANFENG Lu has reported *Polygnathus excavatus* 114 from South China contain *Icriodus*.
- TM John MARSHALL asked about Uzbekistan. The CHAIRMAN commented that conditions in the Kitab Reserve are not the same as they used to be due to the present political situation.
- The topic changed to the **D/C boundary**. TM Thomas BECKER commented on the recently published book on the Rhenish Massif. The conodont taxon *Protognathodus kockeli* has been reported together with a packet of events. For the GSSP, additional markers should be sought. There are many levels there suitable for boundary definition. TM John MARSHALL indicated that first a list of events has to be compiled and then sections should be looked for. The Hasselbachtal auxiliary section is currently not accessible as it is covered.
- CM Peter KÖNIGSHOF announced the forthcoming publication in *Palaeobiodiversity and Palaeoenvironments* next year, the state-of-the-art in the Rhenish Massif. He disagrees with the choice of *Protognathodus kockeli* for definition of the D/C boundary because the taxon is facies-dependent.

CM Sandra KAISER has obtained many siphonodellids in shallow water deposits; in Iran there are no tuff layers but black shales with remarkable geochemical peaks. He highlighted the need to put together all information.

- TM Thomas BECKER indicated that they also sampled the section Royseux in Belgium in shallow water deposits, but no siphonodellids or protognathodids were found there. CM Peter KÖNIGSHOF ascribed this to their dependence on the facies.
- TM Kate TRINAJSTIC reported that in Australia generally not much and very little fieldwork has been done in the last years. However, in New South Wales, some sections previously thought to be Carboniferous have turned out Upper Devonian. These contain long-ranging *Polygnathus* and yielded ‘good sharks’. There is a potential to correlate shark and conodont data. TM Thomas BECKER added that CMs John TALENT and Ruth MAWSON once did a trench in the D/C boundary of the Canning Basin, but results have not been published. TM Kate TRINAJSTIC indicated that the trench doesn’t exist anymore.

6. SDS membership

The Chairman reported that the SDS recruited six new corresponding members in the last year – a very encouraging result! This year, three new CMs were proposed and approved: **Ariuntogos** (Ariuka) MUNKHJARGAL (Mongolia), **Mongkol UDCHACHON** (Thailand), and **Ahmed ZEGHARI** (Algeria). The CHAIRMAN invited Ariuka to talk about her activities. She reported that she is mostly looking for events, fossils, and geochemical data from Mongolia. The CHAIRMAN informed that TM MA Xueping wants to resign and recommended **WANG Yi** as a new TM for China as a substitute. However, as TM Thomas BECKER pointed out, prior to choosing a new TM, she/he must have been an active CM. Therefore, the SDS will ask Xueping to continue until the end of his term in 2024.

7. SDS and Devonian Publications

- TM Thomas BECKER has already finished the SDS Newsletter and informed that the printing costs raised (plus 100 €) due to the paper prices. Münster University doesn’t allow him to send any mail to Russia. A suggestion to keep paper prints to a

minimum was well received, and the Secretary will ask the membership, who would like to have the next SDS Newsletters only in pdf format.

- HARTENFELS, C. HARTKOPF-FRÖDER, & P. KÖNIGSHOF (eds.): The Rhenish Massif: More than 150 years of research in a Variscan mountain chain. - *Palaeobiodiversity and Palaeoenvironments*, **102** (3): 493–829; <https://doi.org/10.1007/s12549-022-00546-y>. CM Peter KÖNIGSHOF gave some comments on this volume.
- WENNDORF, K.-W. (2022): Nucinulidae (Brachiopoda, Rhynchonellida) aus dem Unter- und Mitteldevon des Rheinischen Schiefergebirges und benachbarter Regionen. - *Mainzer Naturwissenschaftliches Archiv, Beiheft*, **36**: 1–189. ISSN 0174-6626.

8. Future Meetings

- STRATI 2023, Lille, 11–13 July 2023. There will be a nice programme including 6 field trips/excursions. A webpage is not available yet, but will be launched soon [it became available soon afterwards]. The SDS has proposed a Devonian session: ‘Devonian paleoenvironments and time’. The convenors would be the SDS officers (Ladislav SLAVÍK, José Ignacio VALENZUELA-RÍOS, and Ulrich JANSEN).
- SDS Meeting in Geneseo, New York, 26 July – 07 August 2023. The long-planned and several times postponed SDS annual business meeting will join the Devonian conference with Devonian fieldtrips in Geneseo, N.Y., in Summer 2023. The SDS gives priority to the N.Y. meeting.
- Other meetings: CM Markus ARETZ is going to organise the next Carboniferous-Permian Congress in Toulouse and offered to expand it to the Devonian. It will take place in July in Toulouse, probably in 2024.
- TM Kate TRINAJSTIC informed that in Australia a Paleo meeting will take place in July next year.
- IGC 2024 will take place in South Korea (July and August).

9. Financial Report

In 2021, the SDS received 4.000 US \$, even more than in most previous years! The support was spent for the production of the SDS Newsletter and officers’ travel supports and special travel grant to (new) CM Ariuka

MUNKHJARGAL, who held an excellent key note talk in our SDS session at the IPC.

10. Any other business

- The new SDS webpage had been launched in the frame of the ICS webpage. The CHAIRMAN thanked Carlo CORRADINI (SDS webmaster) and Nick CARR (ICS webmaster) for producing it, praised its clear arrangement, and underlined the advantages of its embedding within the ICS content. The SDS is among several ICS subcommissions having a functioning web page.
- The CHAIRMAN was asked to present the Klonk section (the first GSSP) in ‘The First 100 IUGS Geological Heritage Sites’, but he had to refuse attending this meeting.
- TM Thomas BECKER commented on an *Earth Science Reviews* paper, which presents controversial data mainly regarding the Devonian as not having stable geomagnetic reversals: VAN DER BOON, A., BIGGIN, A., THALLNER, D., HOUNSLOW, M., BONO, R., NAWROCKI, J., WÓJCIK, K., PASZKOWSKI, M., KÖNIGSHOF, P., DE BACKER, T., KABANOV, P., GOUWY, S. & VANDENBERG, R. (2022). A persistant non-uniformitarian paleomagnetic field in the Devonian? - *Earth-Science Reviews*, 231; <https://doi.org/10.1016/j.earscirev.2022.104073>.
- The ICS Chairman David HARPER thanked for the invitation and commented on the two actual challenges: the Pg/Em and the D/C boundary GSSPs. He also pointed out that the Chronostratigraphy Chart is the ‘flagship’ of the ICS. We would have to focus on the GSSPs and complete our tasks as soon as possible. GSSPs generate a large amount of research; we need to get a plan to set the Emsian. The ICS budget depends on the success in GSSP definitions. He encouraged the chairs to go to the IGC in Korea and also support the STRATI meeting in Lille.
- CM Till SÖTE asked about the D/C boundary criteria.
- CM Ariuka indicated that a manuscript on Late Devonian Events has been submitted. The SDS meeting ended at 10.20 before the start of the IPC Devonian session S9.

Minutes of the (informal) SDS Business Meeting, Lille, France, July 12th

Congress Centre of Lille University “Lilliad”,
Room D, 18:03 to 18:57

**José Ignacio VALENZUELA-RIOS
& Ladislav SLAVÍK**

Participants: 15 persons: LADISLAV SLAVÍK (ChairMAN), JOSÉ IGNACIO VALENZUELA-RíOS (Vice-Chairman), MARKUS ARETZ (CM), HÉCTOR BARRERA (Guest), CATHERINE CRONIER (TM), ANNE-CHRISTINE DA SILVA (TM), CATHERINE GIRARD (CM), JARNO HUYGH (Guest), JAU-CHYN LIAO (CM), JIANFENG LU (CM), GIL MACHADO (Guest), JOHN E. A. MARSHALL (TM), MARIO MORENO (Guest), LI QIAO (guest), CARINE RANDON (CM).

The meeting was developed according to the CHAIRMAN’s agenda (as it was informal, no previous agenda was sent).

1) Introduction

Greetings from the CHAIRMAN, who presented the four present officers and insisted that this meeting is informal because the Annual SDS Business Meeting will take place in Geneseo.

The CHAIRMAN remembers the passing of our long-term member and former CHAIRMAN Pierre BULTYNCK. One minute of silence was held [for his obituary see this newsletter].

2) The CHAIRMAN informs that is not necessary to approve the minutes now. They are the minutes from the IPC6 in Thailand

3) The CHAIRMAN reported that ICS is very busy; Subcommissions are active. He reported on recent approvals of new GSSPs.

4) Regarding ICS matters, the CHAIRMAN informs that the VICE-CHAIRMAN attended the ICS on-line meeting in 2022. Yesterday, the ICS held a face-to-face one. There, chairmen’s reports were centred on promises for the nearest future rather than what has been done by the Subcommisssions. Regarding the Devonian, our promise is to set soon the base

of the Emsian, where two regions are currently being investigated, the Pyrenees in Spain and the Prague Basin in the Czech Republic.

The update of GTS is difficult because new data come during chapter development, just after publication; also new papers are published.

The ICS CHAIRMAN David HARPER demands GTS to be an official ICS publication. However, there are problems, as TM John MARSHALL pointed out, since these were based on a private initiative. The discussion focussed on where to publish the next GTS if it was to be official.

A new ICS Chairman will be elected next year. The CHAIRMAN asked TM Thomas BECKER to become a potential candidate, who refused because of his retirement in early 2026. In the meeting, he asked CM Markus ARETZ.

Then, the CHAIRMAN commented on the need for TMs (Voting Members) renewal.

5) The CHAIRMAN commented briefly on TM Greg RACKI's mail regarding the Frasnian substages. The VICE-CHAIRMAN indicated that both the levels of Frasnian and Givetian substages have been voted on by SDS, but they cannot be official until the base of the Emsian is set (unless regulations have been changed). He informed the answers of the ICS Chair and IUGS Secretary.

6) Regarding the Emsian GSSP, the CHAIRMAN gave a talk in IPC6 and will give another in Geneseo. The VICE-CHAIRMAN will give a talk tomorrow.

CM Markus ARETZ informs about the publication of a special volume in *Palaeobiodiversity and Palaeoenvironments* in 2021 regarding the D/C boundary. He also reported that a proposal to be sent to ICS for approval is being written. Now, the multiproxy approach places the boundary at the end of the Hangenberg Crisis, which is not too far from the current one. They have established a "D/C calender"; but prior to submission it has to be ratified by the Carboniferous Subcommission.

TM Anne-Christine DA SILVA asked for geochemical data.

We came back to the Emsian and the CHAIRMAN informed that new data and, especially, new proxies are coming.

TM John MARSHALL asked if anything new can be expected from Uzbekistan? The Chairman answered that nowadays all is difficult and "sensistive" as the research in the GSSP area greatly depends on the Novosibirsk group.

7) Three new CMs will be proposed for the Business Meeting:

Mario MORENO SANCHEZ, Universidad de Caldas, Colombia (Emsian-Famenian plants from South America)

Gil MACHADO, ChronoSurveys, Portugal, <https://www.chronosurveys.com/> (Petroleum exploration geologist with a Ph.D. in stratigraphy, Palaeozoic palynology)

Jarno HUYGH, University Liege, Belgium (Ph.D. student of TM Anne-Christine DA SILVA - Milankovich cyclicity, sedimentology)

Héctor BARRERA (guest) was asked to introduce himself to the colleagues. He is CM Teresa's Ph.D. student, with the VICE-CHAIRMAN's co-supervision, working on upper Frasnian and Famennian conodont-based biostratigraphy in the Pyrenees. The following day he will present his preliminary results. He could be a potential CM in the near future.

8) The CHAIRMAN reported on information from CM Chuck VER STRAETEN regarding the digitalization of Devonian documents provided by the Paleontological Research Institute (PRI), Ithaca NY; it is a new website, important for Devonian papers to be uploaded. It is planned that the New York field guides will be available online.

9) Future meetings:

- 2nd Asian Paleontological Meeting in Tokio in August 2023
- SDS Geneseo Meeting, end July to early August 2023

- CM Markus ARETZ will organise the International Carboniferous-Permian Congress, probably during the second week of July in Toulouse in 2024. However, next year the Olympics will take place in Paris and this can interfere with the meeting. Therefore, he is thinking to move the meeting to 2025. In the Toulouse, the Devonian, tectonics and geodynamics will be included. It can be a place for a SDS meeting. But a decision still has to be taken.
- IGC 2024 will take place in south Korea (August 2024). This is the event with the official changing of ICS officers and of all subcommission officers.
- International Palynological Congress 2024 in Prague (May 2024)
- ICOS VI in 2025 or 2026 in December in Brazil.

Finally, The VICE-CHAIRMAN informed on the Special Volume honouring the late CM Peter CARLS to be published in 2026 in *Palaeobiodiversity and Palaeoenvironments*. Deadline for manuscripts will be in July 2025.

The Chairman reminded that there is a new Devonian Webpage within the ICS webpage.

MINUTES OF THE SDS ANNUAL BUSINESS MEETING

July 30, 2023, Geneseo, New York State,
USA

**Ralph Thomas BECKER &
LADISLAV SLAVÍK**

Attendance: The CHAIRMAN (L. SLAVÍK, via Zoom). The SECRETARY (U. JANSEN) got stuck in his flight connections and, therefore, arrived after the meeting. TM BECKER took his position in order to record the Minutes.

TMs: C. E. BRETT, D. J. OVER.

CMS: Z. S. ABOUSSALAM, D. A. BARTHOLOMEW, S. GOUWY, D. DE VLEESCHOUWER, A. MUNKJARGAL, J. NAGEL-MYERS, C. VER STRAETEN, J. ZAMBITO.

Guests: D. R. BLOOD (New Brighton, Pennsylvania), D. BOYER (Fort Mill), A. M. BUSH (Tolland, Connecticut), S. CARMICHAEL (Boone), E. DANIELSEN (Columbus), E. M. DOWDING

(Erlangen), N. J. HOGANCAMP (S. Abbington Township, Pennsylvania), J. HUYGH (Liège), B. JACOBI (Buffalo), N. MCADAMS (Lubbock, Texas), S. H. RYAN (Oslo), A. van der BOON (Oslo), C. WAID (Columbus), J. WATERS (Atlanta), N. WICHERN (Münster).

1. Introduction and apologies for absence

The CHAIRMAN welcomed all present members and the numerous guests via Zoom at 16.45 local time. He thanked TM Jeff OVER and his team for the organization of the meeting, which gladly could place after the long, Corona-related delay. He apologized for not being able to attend in person due to family reasons. Of course, he would have loved to take part in the excursions related to the meeting and also thanked all field guides.

Recorded apologies:

TM: R. BROCKE, A.-C. DA SILVA, MA, X.-P., C. SPALLETTA [The Russian TMs are currently banned].

CM: J. DAY, A. EL HASSANI, S. HARTENFELS, S. HELLING, P. KÖNIGSHOF, M. DI PASQUO, SCHINDLER, M. STREEL, S. TURNER [Russian CMs].

2. Minutes of the 2022 SDS Meeting

The last SDS Business Meeting took place in conjunction with the International Palaeontological Congress in Khon Kaen, Thailand, in November 2022. The Minutes will appear in the forthcoming *SDS Newsletter 38*, together with the Minutes of this meeting.

3. CHAIRMAN's Business

The CHAIRMAN reported the sad death of two outstanding SDS members, who both have acted for many years as SDS officers and titular members: Pierre BULTYNCK from Belgium and Alan PEDDER from Canada. He asked for a minute of silence in their honor.

4. ICS Matters

ICS has formally approved the proposal to recognize in future Standard Auxiliary Boundary Stratotypes (SABS) in addition to GSSPs; this was published by HEAD et al.

(2022) in *Episodes* (vol. **46**, 1) and should be considered for the Devonian. A GSSP can have several SABS to cover different environments, continents, climatic zones etc.

A new International Chronostratigraphic Chart, update 04-2023, was published on the ICS homepage.

New GSSPs

- Approval of the Global Boundary Stratotype Section and Point (GSSP) of the Barremian Stage (Upper Cretaceous Series/Epoch). The base of the Barremian Stage is defined by the first appearance of the ammonite species *Taveraidiscus hugii* that is placed at the base of Bed 171 of the Río Argos section, near Caravaca (SE Spain).
- Approval of the Global Boundary Stratotype Section and Point (GSSP) for the Langhian Stage/Age (Middle Miocene Subseries), GSSP at 17.84 m in the ‘Lower La Vedova Beach’ section, central Italy. This level is the mid-point of the marly interval above ‘Megabed IV’ which has been astronomically calibrated to the most prominent ~100-kyr eccentricity maximum, with an astronomical age of 15.981 Ma.
- Approval of the redefinition of the base of the Permian Wuchiapingian Stage GSSP, defined at the base of Bed n6L in the newly exposed Penglaitan section and correlated by the first appearance datum (FAD) of the conodont *Clarkina. postbitteri* sensu lato within the lineage *Jinogondolella granti* → *Cl. postbitteri* → *Cl. dukouensis*, as approved by the Subcommission on Permian Stratigraphy.
- The International Subcommission on Precryogenian Stratigraphy (ISPre-CS) has forwarded a proposal for the formal definition of a new age date for the lower boundary of the Archean Eon or Eonothem. This document proposes the age of 4.000 Ma for the lower boundary of the Archean GSSA.
- At the ICS Business Meeting during STRATI 2023 in Lille, it was pointed out that new ICS and all subcommission officers will be needed starting after the IGC in Busan, South Korea. There is an official call for nominations. As well, new term for all TMs will start. TMs can continue within Subcommissions for 12 years without any voting unless there is a demand

among the membership. It was reminded that a rejuvenation of TMs is essential.

The question of formal substages was only briefly discussed in Lille. Subcommissions can propose substages, which is the case with SDS. It was noted that we will be allowed to move forwards even if the Emsian revision is still stuck. But the CHAIRMAN recommended to wait with substage proposals for at least one more year.

5. Chronostratigraphic revisions

Concerning the **Emsian revision**, there has been an important presentation at STRATI by TM “Nachó” VALENZUELA-RÍOS and co-authors on new conodont and magnetic susceptibility data for Pyrenees sections. In the Prague Synform of Bohemia, the FOD of *Latericriodus gracilis* is the major regional/alternative marker for the Emsian base. This received support at the Geneseo Meeting by new data from the Moroccan Meseta by CM Sarah ABOUSSALAM and co-authors, which was based on field work supported by SDS. It is hoped that a revised Emsian GSSP solution can be reached in 2024.

The Devonian-Carboniferous Boundary Task Group, under the lead of CM Markus ARETZ, gathered also at Lille, preceded by a field trip that examined the proposed GSSP section at Borkewehr and adjacent classical, pelagic sections (Oese, Drewer) in the Rhenish Massif, followed by a visit to classical Ardennes sections in neritic facies (Chinxhe, Anseremme, Royseux, Spontin, Chansin). The Task Group is currently compiling a review of their “DCB Calendar” and working towards a decision on the precise GSSP level within this tight sequence of stratigraphic marker levels, followed later by potential GSSP discussions. A review of Moroccan DCB sections has been prepared for this Newsletter by TM Thomas BECKER and CM Sandra KAISER.

6. SDS Membership

SDS Officers

With the forthcoming new four years period after the 2024 IGC, new **SDS officers** will be required or, unless there is a wish for a ballot among the membership, the current officers can continue for a second term. No proposals for new officers have been made, no wish for a voting was formulated, and the CHAIRMAN, VICE-CHAIRMAN, and SECRETARY agreed to a second term.

New SDS webperson

Since our webmaster, TM Carlo CORRADINI, agreed to candidate for the position of the Chairman of the Silurian Subcommission, he will not continue his homepage work. The search for a successor resulted in the nomination of CM Sofie GOUWY for that position.

Titular Members

A change of **TMs** will take place after the IGC, with proposals by the SDS officers to be voted on by the current TMs in autumn 2023, so that a new TM list can be submitted to ICS in time for the Busan IGC.

New CMs

There are numerous new proposals for new **CMs**, which shows good prospects for our organization:

Randy D. BLOOD, USA (general stratigraphy, sedimentary geochemistry), Wildlands Research, 4116 Marion Hill Rd., New Brighton, Pennsylvania, 15066, USA, randy@drbgeological.com

Diane BOYER, USA (chemostratigraphy), Department of Chemistry, Physics and Geology, Winthrop University, 212 Sims Hall, Rock Hill, SC 29733, boyer@winthrop.edu

Andrew M. BUSH, USA (brachiopods, chemo-, event- and ecostratigraphy), Department of Earth Sciences, University of Connecticut, Andrew.bush@uconn.edu

Sarah CARMICHAEL, USA (chemostratigraphy, geochemistry), Appalachian State University,

ASU Box 32067, 572 Rivers Street, Boone NC, carmichaelsk@appstate.edu

Erika DANIELSEN, USA (Hi-Res stratigraphy, geochemistry, sequence stratigraphy), Ohio Geological Survey, 2045 Morse Rd., Columbus Ohio, erika.danielsen@dnr.ohio.gov

Nicholas J. HOGANCAMP, USA (conodonts, general and sequence stratigraphy), Department of Earth and Atmospheric Sciences, University of Houston, Texas, 77204, USA, hogancampnj@gmail.com

Jargo HUYGH, Belgium (cyclostratigraphy), Liège University, Geology, B20, Allée du Six Août, 12, 4000 Liège, Belgium, jarno.huygh@liege.be

Robert D. JACOBI, USA (structure, tectonics, sedimentology, stratigraphy, Appalachian Basin) University at Buffalo, 124 Century Rd., Buffalo NY, rdjacobi@buffalo.edu

Gil MACHADO, Portugal (general stratigraphy, palynology, reefs, sedimentology, geochemistry), Chronosurveys Lda, Av. 25 Abril, no. 7, 17 dto., 2800-300, Almada, Portugal, machadogil@gmail.com

Neo MCADAMS, USA (conodonts) Texas Tech University, 3215 27th St., Lubbock Texas, neo.mcadams@ttu.edu

Andrés Felipe PASTOR-CHACÓN, Colombia (general stratigraphy), Dirección de Hidrocarburos, Servicio Geológico Colombiano; Carrera 51 # 122-97, Apartamento 202, 111111, Bogotá, Colombia, afpastorc@unal.edu.co

Mario Moreno SANCHEZ, Colombia (Devonian, Emsian-Famenian plants from Colombia), Universidad de Caldas, Cl. 65 #26-10, Manizales, Caldas, e-mail: mario.moreno@ucaldas.edu.co

Christopher B. T. WAID, USA (general and cyclostratigraphy), Ohio Geological Survey, Ohio Department of Natural Resources, 2045 Morse Rd., Building B-1, Columbus, OH 43229, christopher.waid@dnr.ohio.gov

Jonny A. WATERS, USA (general stratigraphy, echinoderms), Department of Geological and Environmental Sciences, Appalachian State University, Boone, NC 2860, USA

All proposals were accepted unanimously.

CM VER STRAETEN warned that SDS should not lose its representation of diverse countries, which, fortunately, could be countered by new members representing Algeria, Portugal, South Africa, Brazil, and Colombia. The CHAIRMAN called for the use of personal contacts to nominate Devonian workers from additional countries.

7. SDS Publications

Several Devonian volumes have appeared or are in preparation. This strongly underlines that SDS is “alive and kicking”.

Outstanding are the **three New York Devonian volumes** published after many years of hard work in the *Bulletins of American Paleontology* by the PRI in Ithaca [see the Devonian Publications section]. They will be on display and ready for order at the meeting banquet in the PRI. All authors are to be congratulated to an effort that resulted in almost 1.000 pages. Furthermore, the PRI offered to place digital versions of Devonian excursion guidebooks on their homepage. This shall happen with the guidebooks of the Geneseo meeting and of previous New York field conferences. TM Thomas BECKER offered to add Moroccan field guides from the 2004 and 2013 meetings. **Proceedings of the Geneseo Meeting** can be submitted until October for another volume of the Bulletins.

A second volume on the **Devonian and Lower Carboniferous of the Rhenish Massif**, celebrating more than 150 years of research in the region, is in preparation, with CMs Christoph HARTKOPF-FRÖDER and Sven HARTFELS as guest editors. Several manuscripts have already been submitted, others are expected towards the end of the year.

The very voluminous book on all aspects of the **Mid-European Variscides**, with U. LINNEMANN as the editor, was planned to be published late in 2023.

At STRATI 2023 in Lille, it was proposed to publish a **special issue** in *Palaeobiodiversity*

and Palaeoenvironments in honor of the late CM Peter CARLS. This is still open for contributions. Dieter UHL followed CM Peter KÖNIGSHOF as the chief editor of the journal.

8. SDS Meetings

The next **IGC** will be held in **August 2024** in Busan, **South Korea**, which, unfortunately, lacks any outcrops of Devonian sediments or faunas. TM Thomas BECKER remarked that only few SDS members will probably attend the IGC and that there should be the option for a smaller-sized meeting elsewhere (Bulgaria?). Another 2024 meeting is the International Palynological Congress in Prague.

CM Markus ARETZ announced that the **20th International Congress on the Carboniferous and Permian** will be held in **2025** (not 2024 -as first considered) in Toulouse. SDS is invited to participate, which gives a good opportunity to return to Devonian outcrops in the Montagne Noire and Pyrenees.

The next **ICOS** will take place either in 2025 or 2026 in Brazil. Since Devonian conodonts are very rare in that country, SDS should evaluate its suitability for a meeting once details become known. Other options for 2026 should be exploited, e.g. the next **IPC**.

The next International Stratigraphic Congress will be **STRATI 2027** in **Valencia**. Since all Subcommissions are supposed to meet at the STRATI congresses, SDS will certainly take part, and even more so, because our VICE-CHAIRMAN was a main proposer.

9. Finances

The support from ICS for 2023 is 3.300 \$, which is slightly less than in 2022. The funds will be used for SDS Newsletter **38**, travel support for SDS officers, and for the Webpage maintenance.

10. Other Business

None was brought up.

SDS DOCUMENTS

The Devonian-Carboniferous Boundary in Morocco: Review and test of the “Devonian-Carboniferous Boundary calendar” of the International DCB Task Group

R. Thomas BECKER & Sandra I. KAISER

1. The Devonian-Carboniferous Boundary (DCB) in Morocco

Although ca. 40 DCB sections/successions have been described from Morocco in the last decades, these do not play a significant role in the current basal Carboniferous GSSP revision.

Unlike as for many other regions (ARETZ & CORRADINI, eds., 2021), a regional DCB review has not been published, which is balanced by this compilation that also considers the revised DCB calendar. The biozonations and the terminology for the Hangenberg Crisis Interval follow the terminology of BECKER et al. (2016, 2021a) and KAISER et al. (2015). Some of the Moroccan sections have very high sedimentation rates, especially in the crisis interval, but lack critical conodont or ammonoid records. However, they have a high potential for future cyclo- and chemostratigraphy, and the reconstruction of patterns and processes at a higher resolution than in the many condensed sections. Also, different palaeogeographic settings, from deltaic siliciclastics to pelagic shelf basin shale sequences are available.

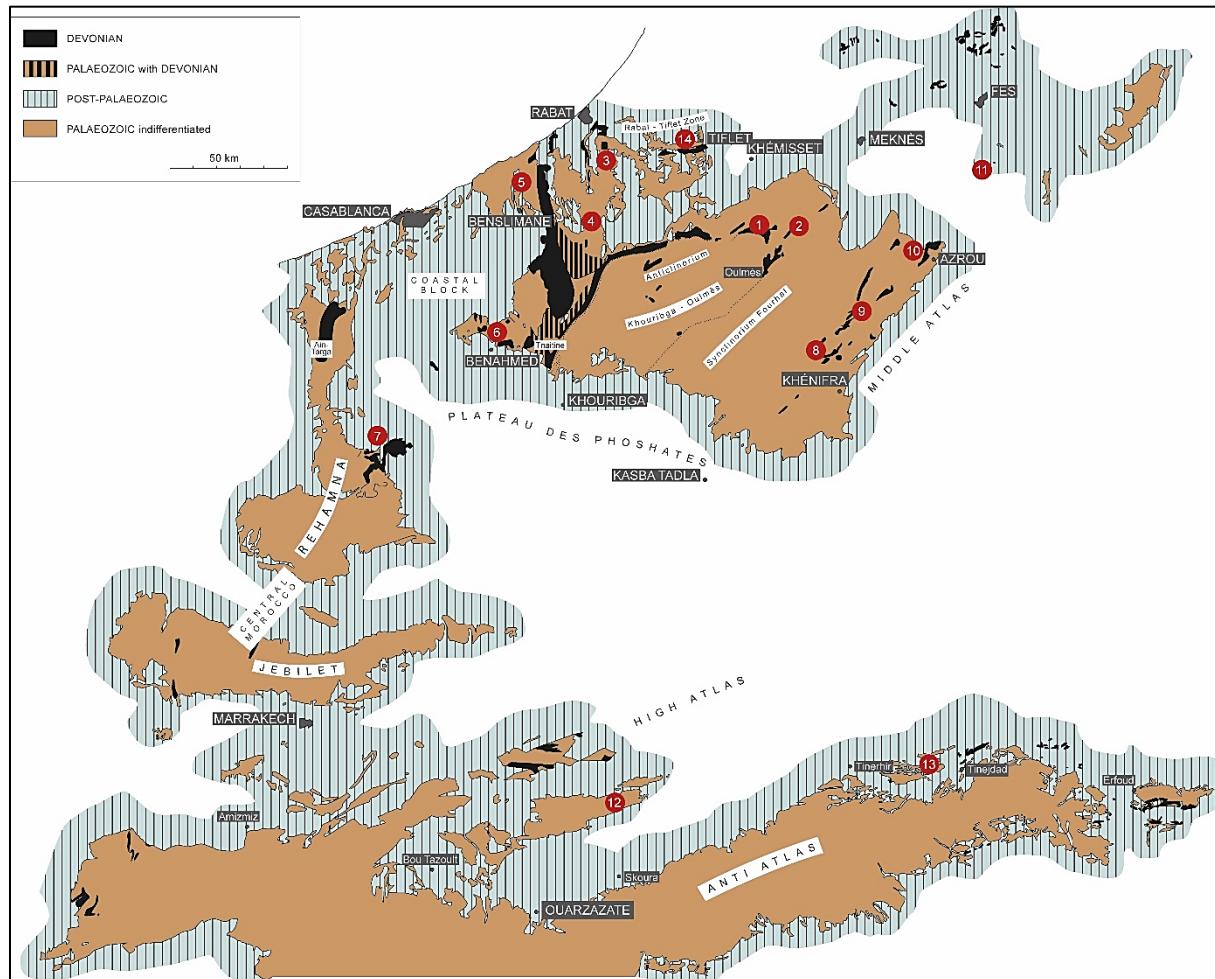


Fig. 1. Location of DCB successions in the Moroccan Meseta. 1 = Oulmes region (Ain Jemaa), 2 = El Hamman Zone (Moulay Hassane), 3 = western Sidi Bettache Basin (Oued Akrech), 4 = Khatouat Massif, 5 = Ben Slimane Zone, 6 = Benahmed region, 7 = Northeast Rehamna, 8 = Ziyyar, 9 = Mrirt, 10 = Azrou, 11 = Middle Atlas Basement (Immouzer-du-Kandar), 12 = Skoura Inlier, 13 = Tisdafine Basin, 14 = Rabat-Tiflet Zone.

2. DCB in the Moroccan Meseta

There are extensive Upper Devonian and Lower Carboniferous outcrops in the structurally complex Moroccan Meseta. Due to intensive Eovariscan block faulting (e.g. BECKER & EL HASSANI 2020), with a peak period in the middle Famennian to middle Tournaisian (Eo-Variscan 1-2 phases of MICHARD et al. 2008), the Meseta outcrops are strongly affected by local uplift, erosion, reworking, sedimentary gaps, slumping, andolistolite displacements at slopes. Combined with macrofauna-poor clastic facies and the later strong overprint by the main Variscan faulting, folding, and cleavage, this results in a low number of sections that have been studied so far with high-resolution (BECKER et al., eds., 2020, 2021).



Fig. 2. The DCB at Ain Jemaa, Oulmes region, with upper Famennian (UD V) nodular cephalopod limestones in the foreground (Bou Gzem Formation), sharply and unconformably overlain by black shales (HBS equivalents), grading into greenish shales/siltstones and sandstones of the Ta'arraft Formation (HS/HBS equivalents).

The best-known section is at Ain Jemaa in the **Oulmes region** (Fig. 1: 1; KAISER 2005;

KAISER et al. 2007), where incomplete pre-crisis nodular limestones (Lower Member of Bou Gzem Formation), Hangenberg Black Shale (HBS; Upper Member of Bou Gzem Formation), Hangenberg Shale (HS, Lower Member of Ta'arraft Formation), and Hangenberg Sandstone (HSS, Upper Member of Ta'arraft Formation) equivalents have been identified (Fig. 2). The latter are overlain by a massive conglomerate/breccia with reworked large reef boulders and griotte clasts yielding redeposited Middle Devonian to Famennian conodonts. The precise timing of this Eovariscan reworking event within the Tournaisian is not yet known.

HSS level sandstones occur also in the adjacent Moulay Hassane area (**El Hamman Zone**, Fig. 1: 2), where the DCB interval has not yet been studied in detail.

Further to the West, there is a thick, obviously complete Famennian-Tournaisian siliciclastic succession in the western **Sidi Betache Basin** (Oued Akrech, Fig. 1: 3). Currently there are only selective biostratigraphic data (CHOUBERT & FAURE-MURET 1961; IZART & VIESLET 1988) but the potential for detailed palynostratigraphy is high (MARHOUMI et al. 1984). The Jebel Akala Quartzites with the last *Retispora lepidophyta* may represent an equivalent of the Rhenish Hangenberg Sandstone (HSS, KAISER et al. 2007). This supposedly deltaic unit is overlain by thin black shales that were dated by spores as middle Tournaisian Lower Alum Shale equivalents (det. M. STREEL in BECKER et al. 2006), followed by shales with a middle Tournaisian *Goniocyclus* fauna in siderite nodules.

To the East, the supposed “Strunian” brachiopod coquinas of the Oued Tiflet (eastern **Rabat-Tiflet Zone**, Fig. 1: 14; LECOINTRE & DELEPINE 1933) turned out to be much younger than formerly thought (Tournaisian/Viséan transition; new brachiopod and trilobite data). The DCB lies in a discontinuous interval with reworking and non-deposition. In the thick siliciclastic Famennian succession of the

Khatouat Massif, (Fig. 1: 4) south of the Sidi Betache Basin, sandstones of the Upper Member of the Bir En-Nasr Formation were given a “Strunian” age (FADLI 1994) but the published palynomorph record does not include *R. lepidophyta* or index species of the LL/LE Zones. The supposedly correlative Souk Jemaa Formation of the southern Khatouat yielded at the top of its shaly-silty Lower Member spores of the LL Zone. This means that overlying quartzites of the Upper Member may include HSS equivalents (FADLI 1994, discussed in KAISER et al. 2007, p. 249); however, this interpretation remains speculative until more palynostratigraphy is done.

To the West, uppermost Famennian hypoxic ammonoid shales of the Aous Bel Fassi Formation (ZAHRAOUI 1991) occur in the **Ben Slimane Zone** (Fig. 1: 5). They contain a still undescribed Wocklum-level (UD VI-B) fauna with *Mayneoceras* (BECKER et al., eds., 2020). There are overlying “Strunian quartzites” with a “*Cyrtospirifer*” brachiopod fauna that require revision, possible HSS equivalents, in the North of Ben Slimane (ZAHRAOUI 1991, FADLI 1994). The region should be tested for palynostratigraphy.

Further to the South, uppermost Famennian silt- and sandstones with brachiopods are also known from the **Benahmed region** (Fig. 1: 6; TERMIER & TERMIER 1951, reviewed in BECKER et al. 2021a). In the adjacent southern **Mdakra Massif**, upper Famennian goniatite shales of the Oued Aricha Formation grade upwards into thick, poorly fossiliferous shales, silt- and thin sandstones of the M’garto Formation (FADLI 1994; BECKER et al. 2021c). The latter should include the DCB interval but palynostratigraphy control is lacking.

Further to the South, in the northeastern **Rehamna** (Fig. 1: 7), near-shore sand bars of the Douar Nahilat Formation of the Mechra-Ben-Abou region and from the Dalaa Member of the Foum el Mejez Formation (GIGOUT 1955; HOLLARD et al. 1982; EICHHOLT et al. 2021) yielded uppermost Famennian (“Strunian”) brachiopod faunas. The subsequent DCB

interval seems to occur in the Foum-el-Mejez region (south of the Oued Kibane, HOLLARD et al. 1982; EL KAMEL 2004) but has not been studied in any detail.

In the eastern part of the Western Meseta, there is an incomplete DCB succession at Ziyyar = Ziar (southern part of **Azrou-Ziyar Nappe**, Fig. 1: 8; WALLISER et al. 1995). Strongly cyclic upper/uppermost Famennian nodular limestones with the *Annulata* and Dasberg Event beds are overlain by possibly HBS/HS equivalents; the biostratigraphic investigations are ongoing. In the **Mrirt region** (Fig. 1: 9), in the middle part of the nappe, the DCB interval was strongly affected by Eovariscan block tilting and reworking (e.g. BECKER et al. 2020). The same crust movements resulted in a DCB gap above a thin layer with uppermost Famennian conodonts in the **Azrou region** (Fig. 1: 10; BOHRMANN & FISCHER 1985; BECKER et al. 2020, fig. 5; ABOUSSALAM et al. 2023). Further to the North, the **Middle Atlas Basement** (Fig. 1: 11), exposed at Immouzer-du-Kandar (ABOUSSALAM et al. 2020) includes thin upper Famennian limestones with conodonts followed by a thick, currently undivided “flyschoid” succession ranging from the uppermost Famennian possibly until the lower/middle Viséan.

In the **Sub-Meseta Zone** (Fig. 1: 12-13) at the originally continuous transition from the Meseta to the cratonic Anti-Atlas region, there is, again, a gap related to Eovariscan tectonism spanning the uppermost Famennian to middle Tournaisian, both in the Skoura Inlier (BECKER et al. 2021c) and eastwards in the Tisdadine Basin of the Tinerhir-Tinejdad region (RYTINA et al. 2013, TALIH et al. 2022).

In the High Atlas, Eastern Meseta, and Rif region, there are no described DCB outcrops.

3. DCB in the eastern Anti-Atlas (Tafilalt/Maïder)

The DCB outcrop situation is much better and partly impressive in the eastern Anti-Atlas,

in the Maïder and Tafilalt regions, where fossiliferous sections can be correlated with high precision for ca. 120 km in SW-NE direction (Fig. 3). The sedimentary successions follow largely the Rhenish “standard”, with the exception that the lower Tournaisian is mostly

siliciclastic, with only local occurrences of thin and often sideritic Hangenberg Limestone equivalents. Strong synsedimentary subsidence variations caused rather variable sediment thicknesses and facies and faunal differentiations. The main DCB sections are:

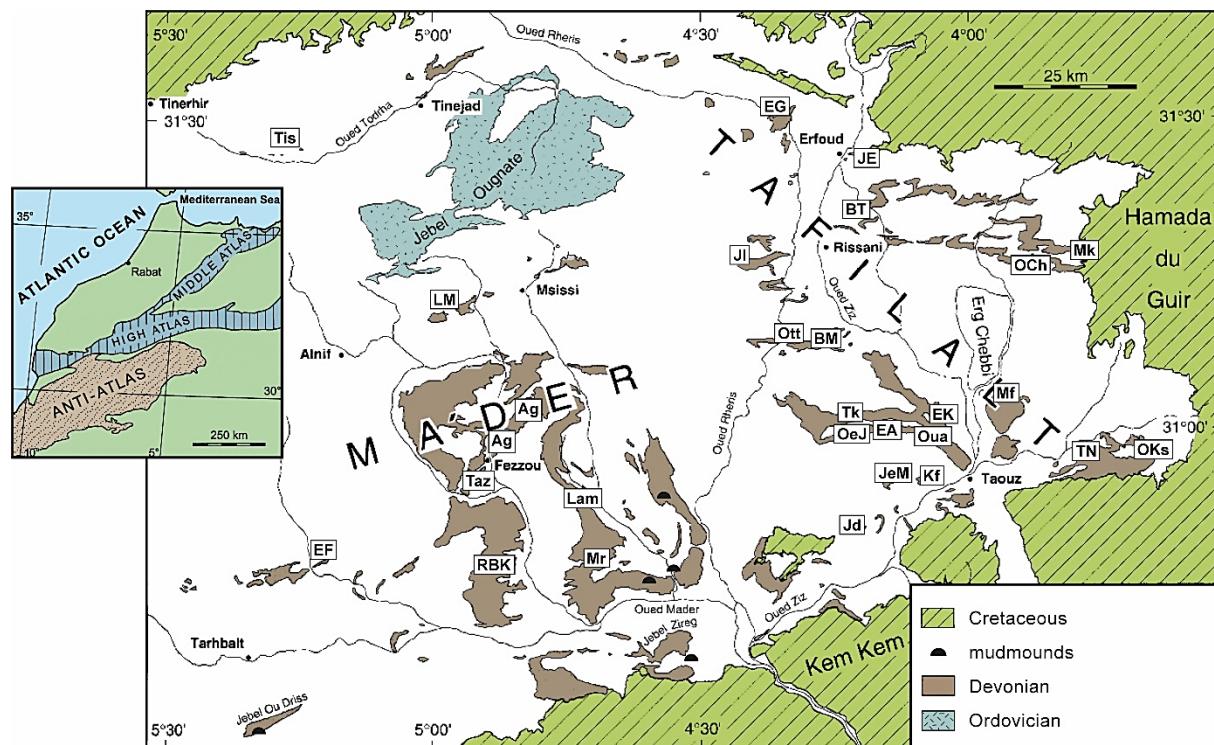


Fig. 3. Location of DCB successions in the eastern Anti-Atlas. EF = El Fecht/Tizi Bou Kerzia, RBK = Rich Bou Kourazia, Taz = Tazoult, Ag = western limb of Aguelmous Syncline (Fezzou to Tizi Ibaouane), Mr = Jebel Mrakib, Lam = Lambidia, LM = Lalla Mimouna, Tk = Takhtbit, OeJ = Oum el Jerane, EA = El Atrous, Oua = Jebel Ouaoufil, Kf = Jebel Kfiroun South, JeM = Jebel Mrier, Jd = Jaid, EK = El Khraouia, TN = Tazoult Nehra, OKs = Oued Kseir, Mf = M'fis, OCh = Ouidane Chebbi, Mk = M'karig, Ott = Ottara East, BM = central Bou Maiz Syncline, BT = Bou Tchrafine, JE = Jebel Erfoud, JI = Jebel Ihrs West, EG = El Gara, Tis = Tisdafine Basin.

Northern Maïder:	Lalla Mimouna	KORN et al. (2004, 2007), BECKER et al. (2011, 2012, 2013b), BECKER (2019)
Southern Maïder:	Fezzou/Bou Tlidat/ Tizi Ibaouane	HOLLARD (1970), KAISER (2005), BRICE et al. (2005, 2007), EBBIGHAUSEN & BOCKWINKEL (2007), KORN et al. (2007, 2013), EBBIGHAUSEN & KORN (2007), FISCHER (2010), KAISER et al. (2011), HAHN et al. (2012), FISCHER & BECKER (2012), GEESINK (2013), KLUG et al. (2016, 2021), BECKER et al. (2018c), KLUG & VALLON (2018), BECKER (2019), HOFMANN et al. (2020), GREIF et al. (2022)
	Tazoult	HAHN et al. (2012), KORN et al. (2013), BECKER et al. (2018c), BECKER (2019)
	Rich Bou Kourazia	BECKER et al. (2002), WEBSTER et al. (2005)
	Mrakib	KORN (1999), BECKER et al. (2000, 2002)
	Lambidia	BECKER et al. (2002), KAISER (2005), FISCHER (2010),

		KAISER et al. (2011), KORN et al. (2013)
Maïder Platform:	Tizi n'Izelguene	WENDT (1989)
	Tizi Bou Kerzia/El Fecht	WENDT (1989)
Southern Tafilalt:	Takhbtit	KORN et al. (2000), HARTENFELS (2011), HARTENFELS & BECKER (2016)
	Oum el Jerane	KORN et al. (2000), HARTENFELS (2011), BECKER et al. (2013a), HARTENFELS & BECKER (2016, 2018)
	El Atrous	WENDT (1988), KORN et al. (2000), KAISER (2005), BRICE et al. (2005, 2007), KAISER et al. (2011, 2013, 2018), HAHN et al. (2012)
	Jebel Ouaoufilal	KORN et al. (2000), KAISER (2005), KAISER et al. (2011), HARTENFELS (2011), BECKER et al. (2016), HARTENFELS & BECKER (2016), KLUG & POHLE (2018)
	El Khraouia	HARTENFELS et al. (2013), ABOUSSALAM & BECKER (2015)
	Jebel Kfiroun South	ABOUSSALAM & BECKER (2015), HARTENFELS & BECKER (2016)
	Jdaid	WENDT (1988)
Eastern Tafilalt:	M'fis	BECKER et al. (2002), KAISER (2005), BOCKWINKEL & EBBIGHAUSEN (2006), KORN et al. (2007), KAISER et al. (2011)
	Ouidane Chebbi	WENDT et al. (1984), BELKA et al. (1999), KORN (1999), KAISER (2005), KAISER et al. (2011)
	Ouidane Chebbi NW	BECKER et al. (2006), HARTENFELS (2011)
	M'karig	BECKER et al. (2002, 2006), KAISER (2005), BRICE et al. (2005, 2007), KAISER et al. (2011), HAHN et al. (2012), BECKER (2019)
Southeastern Tafilalt:	Tazoult Nehra	FISCHER (2010), FISCHER & BECKER (2012), BECKER & ABOUSSALAM (2015)
	Hassi Nebech	HARTENFELS (2011)
	Oued Kseir	WENDT (2021)
Central Tafilalt:	Jebel Erfoud	DELEPINE (1941), ALBERTI (1970), WENDT et al. (1984), WENDT (1988), KORN (1999), HARTENFELS (2011), HARTENFELS & BECKER (2016), BECKER (2019)
	Bou Tchrafine	HARTENFELS & BECKER (2016), BECKER et al. (2018a)
	Ottara East	HARTENFELS & BECKER (2016)
	Bou Maiz Syncline	WENDT et al. (1984, 2002), LUBESEDER et al. (2010)
Western Tafilalt:	Jebel Ihrs	WENDT et al. (1984), WENDT (1988), HARTENFELS & BECKER (2016), BECKER et al. (2018b)
Northern Tafilalt:	El Gara	BECKER (1993)

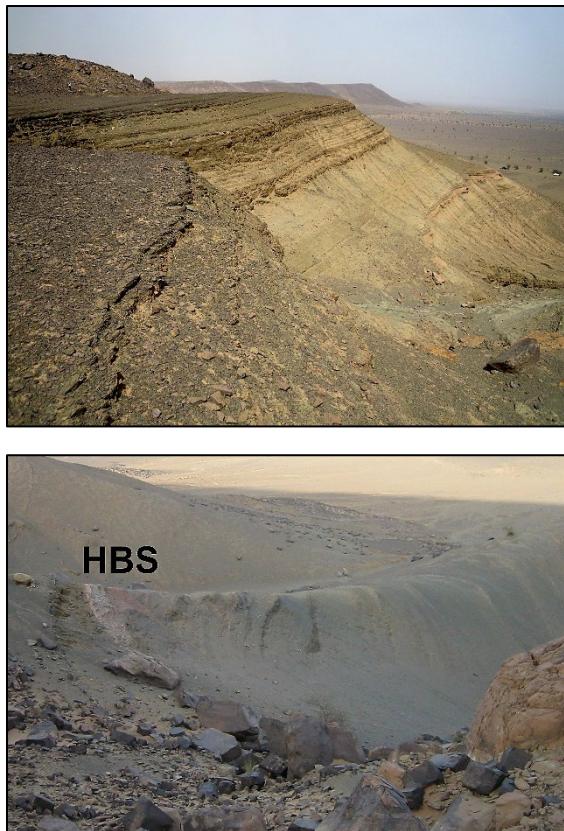


Fig. 4. DCB sections of the Aguelmous Syncline (southern Maïder). Upper photo: Mrakib, overview of the Mrakib Member (starting with a reddish interval in the middle slope on the right) and the Jebel el Krabis Member (both Ibaouane Formation) of the upper terrace, followed (to the left and in the distance) by the marked cliff of the Aguelmous Formation (HS/HSS equivalent). Lower photo: reddish weathering HBS equivalent overlying the greenish-grey weathering Jebel el Krabis Member (to the right), Lambidia, eastern limb of syncline.

In the **southern Maïder**, goethitic (originally pyritic, UD VI-A to VI-C) or sideritic (UD VI-D, *Wocklumeria oblivia* fauna, EBBIGHAUSEN & KORN 2007) faunas from hypoxic shale equivalents of the Rhenish Wocklum Limestone fall in the upper part of the Jebel el Krabis Member of the Ibaouane Formation (BECKER et al. 2018c; Fig. 4). The overlying Hangenberg Black Shale (HBS) equivalents were named as Bou Tlidat Member (Fig. 4, lower photo) and yielded rather unique fossils (KLUG et al. 2016, 2021; KLUG & VALLON 2018; GREIF et al. 2022). The overlying very thick, siliciclastic Aguelmous Formation (Fig. 4, upper photo) can be

subdivided into three members: an unfossiliferous siltstone package equivalent to the Hangenberg Shale (HS), shallowing upwards sandstones forming the main Aguelmous/Tazoult cliffs, equivalents of the Hangenberg Sandstone (HSS), and thick, cyclic siltstones and turbiditic sandstones indicating roughly the Stockum level deepening phase. The return to pelagic goniatite shales, intercalated by fossiliferous sideritic sandstones, defines the Fezzou Formation, which base is younger (ca. LC I-C) than the base of the Rhenish Hangenberg Limestone (base of LC I-A2). Intercalated sandy limestones yielded very rare post-event conodonts (Fig. 5).

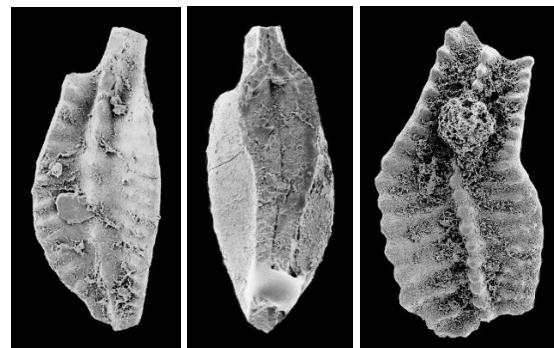


Fig. 5. Rare lower Tournaisian siphonodellids from the Tafilet/Maïder; left and middle = *Siphonodella (Eosiphonodella) sulcata* Gp. 4 sensu KAISER & CORRADINI (2011), Bou Tlidat, Aguelmous Syncline, Bed 20 = X1a; right = *Si. (Eosi.) bransoni*, M'karig, eastern Tafilet, Beds 39-40.

Knowledge of the DCB transition of the **Maïder Platform** further to the Southwest is still limited. According to WENDT (1989), the Aguelmous Formation sits unconformably on upper Famennian limestones, including locally the upper Famennian *Gonioclymenia* Limestone (UD V-B), but it is more silty and not as massive as at the Aguelmous.

In the **northern Maïder**, Wocklum Limestone equivalents are represented by crinoidal limestones of the Lower Member of the Lalla Mimouna Formation; HBS equivalents are not exposed. The Aguelmous Formation is represented by a brachiopod-rich, thin silt- and sandstone tongue (= Middle Member of Lalla Mimouna Formation sensu BECKER et al. 2013) grading upwards into the

crinoidal Upper Member of the Lalla Mimouna Formation (BECKER et al. 2013). The latter unit yielded the globally richest conodont faunas of the (higher) *costatus-kockeli* Interregnum (*ckI*), including “siphonodelloids”. Very locally, there is a thin, laterally wedging out tongue of black, crinoidal cephalopod limestone (only at Lalla Mimouna North), a Lower Stockum Limestone equivalent with *Postclymenia* and *Acutimitoceras* (*Stockumites*) (KORN et al. 2004). Strongly negative carbon isotope values (down to -17‰) signal a massive recycling of isotopically light C_{org} during the strong recrystallization of the bed (BECKER et al. 2013). Above the last crinoidal limestones of the Lalla Mimouna Formation, which fall in the higher *Siphonodella* (*Siphonodella*) *mehli* Zone, the Fezzou Formation is developed, as in the southern Maïder, as hypoxic goniatite shale.

In the Amessoui Syncline of the southern Tafilalt, the *Gonioclymenia* Limestone (KORN

et al. 2000, HARTENFELS & BECKER 2016) forms a thin tongue of the Erfoud Member (upper Achguig Formation, UD V-B). Due to non-deposition, there are practically no Wocklum Limestone equivalents at Takhbtit, Oum el Jerane, Jebel Ouaoufilal, and Jebel Kfiroun South. At Oum el Jerane, a record of *Bispachodus ziegleri* = *Bi. ultimus ultimus* in GINTER et al. (2002) suggests that thin uppermost Famennian limestones may be locally encrusted on the *Gonioclymenia* Limestone. Only at El Atrous, there is evidence for uppermost Famennian thin marls and limestones nodules of UD VI-C with trilobites and *Parawocklumeria* (e.g. KAISER et al. 2018). Further to the South, at the Jebel El Mrier (ABOUESSALAM & BECKER 2015), the DCB hiatus is extended, with upper Tournaisian shales with *Merocanites* transgressing a Givetian shallow-water platform with corals.



Fig. 6. The DCB section at El Atrous, southern Tafilalt (southern limb of Amessoui Syncline), with the very thick, cyclic and silty Lower Member of the Ouaoufilal Formation in the lower slope (right, HS equivalent) ending at a marker sandstone that grades laterally (westwards, left) into a marine incised valley fill and with a sequence boundary at the base. This marks the base of HSS equivalents (Middle Member) shallowing upwards to the rugged, brachiopod-rich sandstones at the cliff top (right background).

Thin HBS equivalents have not yet received a local lithostratigraphic term in the southern Tafilalt. They have not been seen in western parts of the Amessoui Syncline or at Jebel Kfiroun South. But they occur at El Atrous and

along the northern side of the Jebel Ouaoufilal. The overlying, very thick silt- and sandstones exposed all along the Amessoui Syncline fall in the Ouaoufilal (= Aoufital) Formation. As in the Aguelmous Formation of the Maïder, thick,

cyclic, silty (HS) equivalents form a Lower Member, which includes locally a thin, sideritic layer with *Acutimitoceras* (*Stockumites*) aff. *subbilobatum* (HAHN et al. 2012; BECKER et al. 2016). HSS equivalents form a Middle Member, with a basal incised valley fill at El Atrous (KAISER et al. 2018; Fig. 6). Sandstone parasequences with brachiopod-rich layers continue up to the cliff top. A subsequent deepening forms on the backside of the Amessoui DCB ridge an Upper Member with more brachiopod layers. This unit reaches, unlike the corresponding Aguelmous Formation of the Maïder, up to the Lower Alum Shale Event a of the basal middle Tournaisian. However, the Upper Member includes a poorly exposed, unfossiliferous siltstone package (El Atrous, Beds 37-38, KAISER 2005) that correlates with the Fezzou Formation.

In the eastward transition to the **Tafilalt Basin** (eastern end of Amessoui Syncline, El Khraouia, and at Tazoult Nehra), lower Wocklum strata (UD VI-A/B) are represented by pyritic, anoxic ammonoid shales (FISCHER 2010; HARTENFELS et al. 2013; KLUG & POHLE 2018), here named as new **Tazoult Nehra Member** (type-section at Tazoult Nehra). HBS equivalents have not yet been observed below the Ouaoufil Formation, which cuts locally, in the eastern part (Oued Kseir, WENDT 2021), down into the Erfoud Member.

From there to the North, in the **eastern Tafilalt**, at M'fis, the Erfoud Member ends earlier, with non-deposition beginning low in UD V before the *Gonioclymenia* Limestone level (KAISER et al. 2011). HBS equivalents and the thick Lower/Middle Ouaoufil Formation are similarly developed as in the Amessoui Syncline (KAISER 2005; KAISER et al. 2011). But the sandstones of the Upper Member grade above an originally pyritic “white shale” into an alternation of fossiliferous (goniatite-rich) pelagic shales and sideritic sandstones, here named as **M'fis Member** (type locality at M'fis, Beds 45-52 of KAISER 2005, Beds 1-11 of BOCKWINKEL & EBBIGHAUSEn 2006; ca. 15 m thick). The base is older (LC I-A3/B) than the

base of the Fezzou Formation in the Maïder but a peculiar *Cruziana* Bed enables a precise correlation between both distant regions (KAISER et al. 2011; GEESINK 2013; BECKER et al. 2018c; HOFMANN et al. 2020).

Further northeastwards, at Ouidane Chebbi West, Ouidane Chebbi, and M'karig, equivalents of the lower/middle Wocklum Limestone are developed again, reaching well into the *praesulcata* Zone and well above *Kalloclymenia* faunas (BELKA et al. 1999; BECKER et al. 2002; KAISER et al. 2011). HBS equivalents are distinctive. The Lower and Middle Members of the sandy Ouaoufil Formation are significantly thinner than in the Amessoui Syncline. Sandstones with shallow subtidal current ripples mark the onset of HSS equivalents (KAISER et al. 2011).

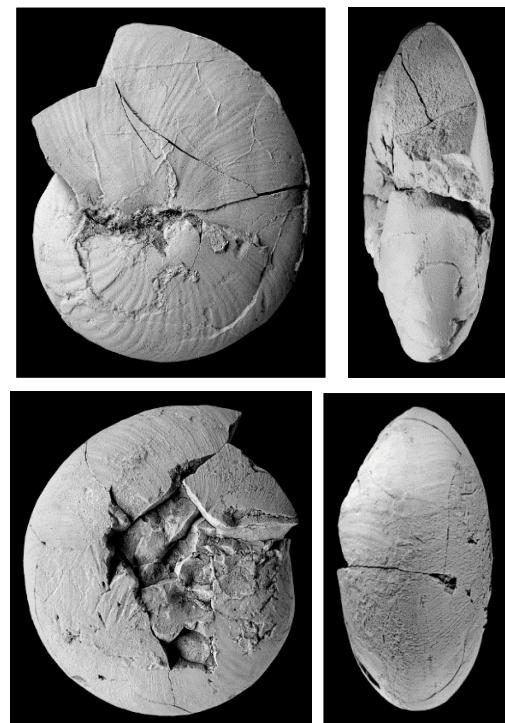


Fig. 7. Two different species of *Ac.* (*Stockumites*) spp. (Geomuseum Münster, GMM B6C.61.3-4, max. diameter 59 and 54 mm) from the base of the turbiditic sandstone at the top of the Middle Member of the Ouaoufil Formation (Bed 37) of M'karig (eastern Tafilalt)

The more argillaceous Upper Member ends upwards with a turbiditic goniatite sandstone with various *Ac.* (*Stockumites*) (Fig. 7),

bivalves, rare spiriferids, and *Pudoproetus zhoreae* (KORN 1999; BECKER et al. 2002; HAHN et al. 2012). It is sandwiched between pyritic goniatite shale with various fauna, e.g. oxyconic bellerophontids (ca. Upper Stockum level, BECKER 2019). These are followed at M'karig by unfossiliferous shales with intercalated thin nodular limestones (KAISER et al. 2011), here named as **M'karig Member** (type locality at M'karig, ca. 7 m thick). Based on rare *Siphonodella (Eosiphonodella) bransoni* (Fig. 5) and *Si. (Si.) duplicata* sensu HASS = *Si. (Si.) cf. wilberti*, the upper part falls in the *Si. (Si.) mehli* Zone and can be correlated with the upper part of the M'fis Member and with the Fezzou Formation of the Maïder. A loose, goethitic *Gattendorfia* from Ouidane Chebbi indicates a gradual transition towards the M'fis Member.

In the **Bou Maiz Syncline** of the southern central Tafilalt, up to the Ottara region in the West, the Ouaoufilal Formation and its members are typically developed (LUBESEDER et al. 2010; HARTENFELS & BECKER 2016). At its unconformable, partly erosive base (Jebel Bou Ifarheriou, WENDT 2021), there are, however, no HBS outcrops and the Erfoud Member does not reach the Wocklum Limestone level (WENDT et al. 1984; WENDT 1988; HARTENFELS & BECKER 2016), as in western parts of the Amessoui Syncline to the South.

In the **central Tafilalt** (Bou Tchrafine, BECKER et al. 2018a), cephalopod limestones range higher, reaching lower Wocklum Limestone equivalents (UD VI-A). The last limestone nodules of the Jebel Erfoud contain *Parawocklumeria paradoxa* (KORN 1999), the UD VI-C2 marker. Only there it can be shown that top-Tournaisian sideritic shales transgressed unconformably the Erfoud Member (DELEPINE 1941; BECKER 2019). The whole **northern and western Tafilalt** is peculiar because there is no evidence for sandstones of the Ouaoufilal Formation (Fig. 8). At Jebel Ihrs, the Erfoud Formation ends with separate *Gonioclymenia* and *Kalloclymenia* Limestones; the latter with “siphonodelloids”

(HARTENFELS & BECKER 2016). Potential DCB deposits are mostly covered by the Quaternary in wide plains and the age of a thick silt succession (e.g. at Jebel Ihrs/Amelane, WENDT et al. 1984; WENDT 1988) is unclear.

The same situation applies to the **Rheris Basin** in the northern Tafilalt, where the youngest known Erfoud Member faunas predate the Wocklum Limestone level (El Gara, UD V-A2/B, BECKER 1993, p. 116). WENDT et al. (1984, p. 616) mentioned from El Gara an overlying debris flow with reworked blocks from the Erfoud Member, which suggests a block faulting event in the wider DCB interval. Since the deltaic sandstone lobes of the Ouaoufilal Formation did not reach the central and northern Tafilalt coming from the South, the provenance of HSS equivalent sandstones beyond, in the Meseta, is un-resolved.



Fig. 8. Overview of the DCB interval at the Jebel Ihrs (western Tafilalt), with the upper Famennian *Gonioclymenia* Trenches (including the *Kalloclymenia* Limestone, UD VI-A) running along the ridge, followed in the plane and center of the syncline (photo center and right) by thick, deeply weathered, unfossiliferous Carboniferous shales of unclear age; HSS equivalents of the Ouaoufilal Formation are not developed.

4. DCB in the Dra Valley

The DCB interval of the **Eastern Dra Valley** is best exposed in the Zemoul (Dfeif to Tinfouchy area), but it now lies on the Algerian side and is very difficult to access. HOLLARD (1970) published a transect that shows a shale with “*Gattendorfia crassa*”. This is a species that is now placed in *Zadelsdorfia* (KORN & WEYER 2023) but the regional identification

requires revision, especially since Tafilalt (M'fis) specimens now fall in *Z. zana* KORN & WEYER, 2013. The goniatite level is underlain by variably thick sand- and siltstone packages that, again, are younger than an upper/?uppermost Famennian goniatite shale.

The upper goniatite shale with gattendorfids seems to correlate with the Fezzou Formation, the sandy middle part with the Aguelmous Formation, and the lower goniatite shale with the pre-event Jebel El Krabis Member of the Ibaouane Formation of the Maïder Basin.

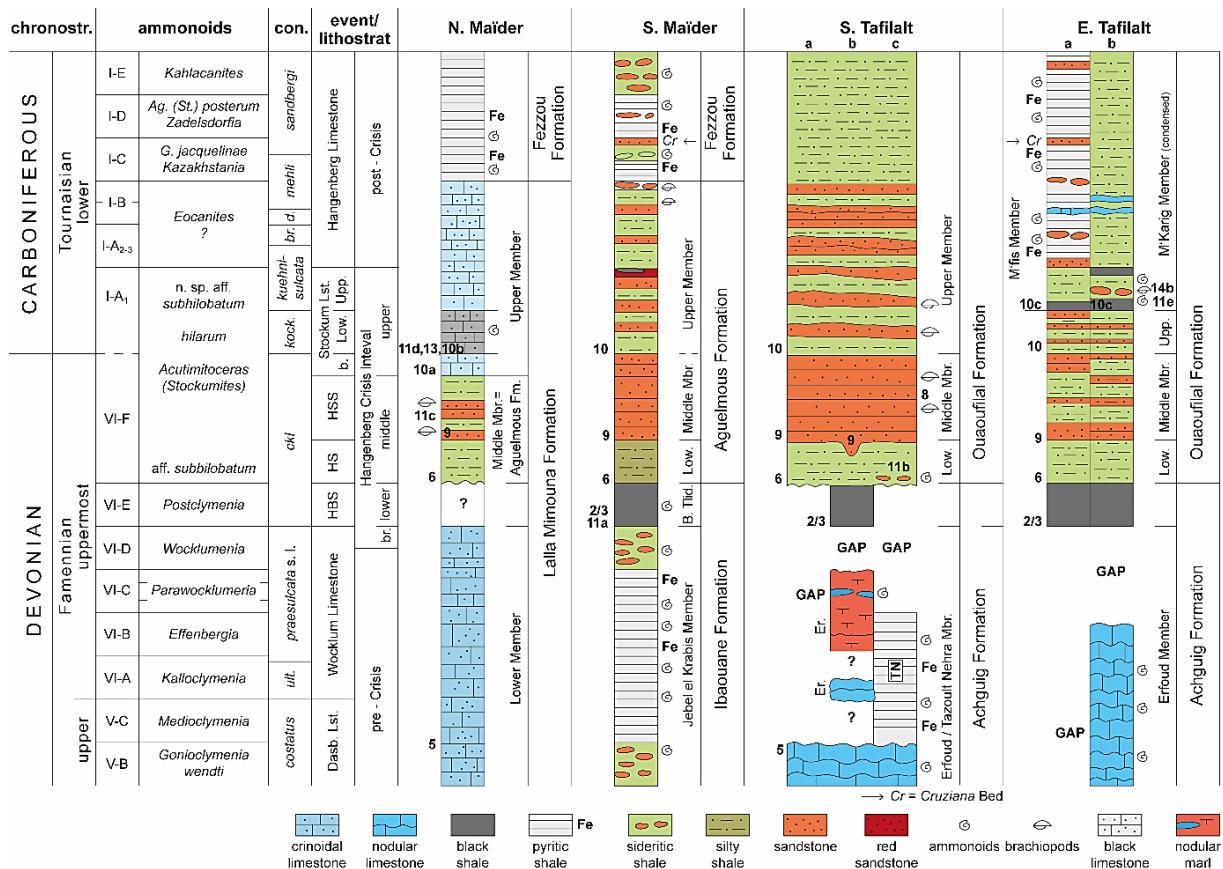


Fig. 9. Correlation of DCB successions of the northern Maïder (Lalla Mimouna), southern Maïder (Aguelmous Syncline: Rich Bou Kourazia-Tazoult-Bou Tlidat-Jebel Mrakib-Lambidia), Amessoui Syncline of the southern Tafilalt (a: Oum el Jerane, b: El Atrous, c: Jebel Ouaoufil to El Khraouia and Tazoult Nehra), and eastern Tafilalt (a: M'fis, b: Ouidane Chebbi to M'Karig), with the position of the regionally recognizable DCB steps.

In the Western Dra Valley, ca. from the South of Akka to the West, the three Tazout Formations of HOLLARD (1970) embrace the upper Famennian to basal upper Tournaisian. In the revised lithostratigraphy of KAISER et al. (2004), Tazout 1 equals the brachiopod-rich lower part of the Maader Talmout Member of the Tazout Formation (Beds -7 to -1 at Kheneg Lakahal). It yielded the Lower Brachiopod Fauna sensu BRICE et al. (2007) that contains upper/uppermost Famennian taxa and is pre-Hangenberg Event in age. The silty, less

fossiliferous middle part of the Maader Talmout Member equals the lower part of Tazout 2, which yielded an intermediate brachiopod fauna. The more sandy, upper part of the member is, again, very fossiliferous and represents the upper Tazout 2. At its base at Kheneg Lakahal, a limestone lense within siltstones of Bed 2 with conodonts (*Palmatolepis*-bispathidid fauna, KAISER et al. 2004) and a trilobite (*Pseudowaribile*, HAHN et al. 2012) indicate still a pre-event (top-Wocklum) age. But the Upper Brachiopod

Fauna sensu BRICE et al. (2007) of the main Tazout 2 interval has a Tournaisian-type composition. This suggests their correlation with the Aguelmous/Ouaoufilal Formations, as proposed by HOLLARD (1970). The overlying, poorly fossiliferous, thick Kheneg Lakahal Member equals Tazout 3 and correlates with the Fezzou Formation and overlying middle to lower upper Tournaisian strata of the eastern Anti-Atlas (Rharriz Formation of the Maïder, Oued Znaïgui Formation of the southern and eastern Taifilalt).

5. Recognition of the DCB steps in Morocco

The following steps around the DCB (Fig. 9) have been agreed on by the Task Group and shall aid the global correlation of the future GSSP level in different regions and facies settings, especially when the defining criterion is locally not recognizable. As shown below and in Fig. 8, not all steps/criteria are equally useful and a range of them have currently no Moroccan record. The Task Group is currently preparing an evaluation of the steps based on their global reviews.



Fig. 10. Strongly corroded *Gattendorfia* sp. (GMM B6C.61.1, diameter 26 mm) reworked in the Carboniferous (probably middle Tournaisian) synsedimentary breccia of the Jebel Ardane (Merzouga region, Taifilalt).

Step 18. Historical Heerlen Boundary (= base of Hangenberg Limestone equivalents and FOD of *Gattenforfia*)

Not recognizable. In the eastern Taifilalt (M'karig), thin equivalents of the Hangenberg Limestone post-date Step 18 and the oldest pyritic/goethitic *Gattendorfia* faunas of the

Fezzou Formation (Maïder) or M'fis Member (Taifilalt Basin) fall already in LC I-C (*G. jacquelineae* Zone). A single *Gattendorfia* (resembling in terms of conch parameters the German *Zadelsdorfia crassa*) in pelagic, oxic limestone preservation came from a middle Tournaisian reworking unit of the Taouz region (Jebel Ardane, see TAHIRI et al. 2013; Fig. 10). Currently, there are no conodont faunas from the *Siphonodella* (*Eosiphonodella*) *sulcata* s.l. Zone in Morocco.

Step 17. End of DCB positive carbon isotope excursion

Not yet recognizable. So far, there are only few carbon isotope data for the Famennian/Tournaisian of Morocco.

Step 16. DCB level in the La Serre GSSP

Not recognizable because of the completely unclear/imprecise global correlation of the current GSSP level, which lacks any definite criterion.

Step 15: Peak of the main positive DCB $\delta^{13}\text{C}_{\text{carb}}$ excursion

Not yet recognizable (see Step 17).

Step 14b: Base of *Protognathodus kuehni/Siphonodella* (*Eosiphonodella*) *sulcata* s.l. Zone

Due to the absence of *Postclymenia*, which is rather abundant in the Lower Stockum fauna of Lalla Mimouna North (Fig. 11), the fauna with *Ac.* (*Stockumites*) div. sp. (KAISER et al. 2011; BECKER 2019) from low in the Upper Member of the Ouaoufilal Formation at M'karig has been tentatively correlated with the Rhenish Upper Stockum level.

Step 14a: “Coastal swamp” plant extinction (LN/VI zonal boundary)

Not yet recognizable. So far, there are too few and sporadic palynological records from the DCB of Morocco. However, there is good research potential in thick clastic wedges of several Meseta regions (e.g. Sidi Bettache

Basin, Khatouat), while the deep arid weathering delimits the potential in the HSS equivalents of the Anti-Atlas.

Step 13. Base of *Protognathodus kockeli* Zone

Recognized only at Lalla Mimouna North in the northern Maïder (KORN et al. 2004,), where a thin, dark, organic-rich, crinoidal limestone with *Postclymenia calceola* KLEIN & KORN, 2004 (Fig. 11) and *Ac. (Stockumites) hilarum* (KORN, 2002), a Lower Stockum Limestone equivalent and tongue of the Middle Aguelmous Formation, transgressed over thin silt- and sandstones of the Middle Crisis Interval. The section is tectonized and not continuous with the main Lalla Mimouna section down the slope.

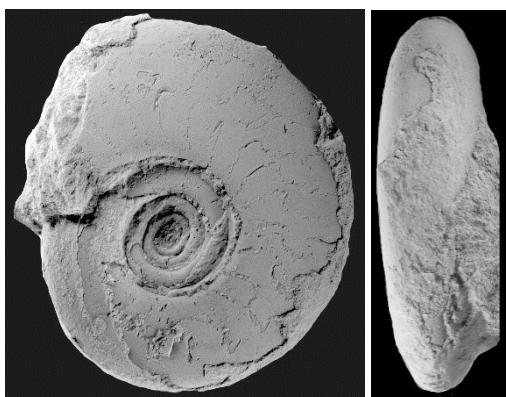


Fig. 11. *Postclymenia calceola* KLEIN & KORN, 2004 (GMM B6C.61.2, dm = 35 mm) from the crinoidal Stockum Limestone at Lalla Mimouna North.

Step 12. Onset of the main positive DCB $\delta^{13}\text{C}_{\text{carb}}$ excursion

Not yet recognizable: The Lower Stockum level of Lala Mimouna North yielded a strongly negative isotope values, due to intensive organic matter recycling during diagenetic recrystallization (BECKER et al. 2013).

Step 11. Post-extinction diversification

Post-extinction re-diversification occurred, as everywhere, in several steps and variably within different fossil groups. In the HBS fauna from the Jebel Mrakib (KLUG et al. 2016), possible oldest *Acutimitoceras* (*Stockumites*) occur earlier than elsewhere, already in UD VI-

E (regional Step 11a). At Jebel Ouaoufilal in the Amessoui Syncline, *Ac. (Stockumites) aff. bilobatum* enters at a slightly higher level, very low in HS equivalents (basal Lower Member of Ouaoufilal Formation, basal Middle Crisis Interval I; BECKER in HAHN et al. 2012; BECKER et al. 2016; regional Step 11b). The next episodes of goniatite radiation, also of conodonts (*Protognathodus kockeli*), are in the Lower Stockum level at Lalla Mimouna North (regional Step 11d) and in the supposed Upper Stockum level fauna of M'karig (regional Step 11e). The latter assemblage yielded also the oldest Moroccan Carboniferous-type trilobites (*Pudoproetus zhorae* HAHN & MÜLLER in HAHN et al., 2012) and other faunal elements, such as gastropods and the brachiopod *Tylothyris* (BRICE et al. 2005). The largest regional radiation of ammonoids, trilobites and other benthos (e.g. the *Cruziana*-forming arthropod, Carboniferous-type gastropods, such as *Euphemites*) post-dates the DCB interval and falls in the *Gattendorfia jacquelinae* Zone (LC I-C; e.g. FREY et al. 2018; BECKER et al. 2018c).

In the neritic DCB succession of the western Dra Valley (KAISER et al. 2004; BRICE et al. 2007), the Carboniferous-type Upper Brachiopod Fauna begins at Kheneg Lakahal just above the last pre-Hangenberg conodonts and trilobite (*Pseudowaribile*, HAHN et al. 2012), therefore ca. in the regional Steps 11a/b. There is also a radiation of brachiopods in the tongue of the Aguelmous Formation at Lalla Mimouna (HSS equivalents, Middle Crisis Interval II, BECKER et al. 2013; regional Step 11c) and, to a lesser extent (FAD of *Hemiplethorhynchus*), in the corresponding Middle Ouaoufilal Formation of the Amessoui Syncline (KAISER et al. 2011, 2018).

Step 10. Top of major regression (end of Hangenberg Sandstone deposition)

This level is regionally gradual, not very distinctive, and the re-appearance of pelagic faunas is not isochronous within the thick siliciclastic wedges of the Aguelmous and Ouaoufilal Formations of the eastern Anti-

Atlas. In the southern Maïder and Amessouï Syncline, the “end of regression” can be approximated by a gradual change from (pro)deltaic to turbiditic sandstones and the return of alternating thick silt packages (KAISER 2005; KAISER et al. 2011), which define the upper members of both formations. In the northern Maïder, the gradual transition from the silty-sandy tongue of the Aguelmous Formation to the crinoidal Upper Member of the Lalla Mimouna Formation pre-dates the Lower Stockum level due to its rich *cki* conodont faunas (still without *Pr. kockeli*, Step 10a). With increasing transgression (Step 10b) pelagic macrofauna returns in the *kockeli* Zone.

The end of regression is not precisely dated in the Tafilalt Basin, where the M'fis Member begins with a possibly anoxic shale somewhat below the occurrence of the first Hangenberg Limestone level ammonoids. At Ouidane Chebbi and M'karig in the eastern Tafilalt, the return of pelagic fauna is thought to correlate with the Upper Stockum level (Step 10c, *kuehni-sulcata* s.l. Zone), well above the base of the Upper Ouaoufilal Formation.

In the Meseta, the Eovariscan tectonics and poor palynostratigraphy does not yet allow any conclusions concerning Step 10. Apart from rare reworked *Si. (Si.) bransoni* (BECKER et al. 2021b) in Viséan strata of the Benahmed region, there is no lower Tournaisian pelagic fauna.

Step 9. Sudden regression/beginning of Hangenberg Sandstone equivalents (base of Middle Crisis Interval II)

The sudden regression of Step 9, partly with incised valley fill successions (El Atrous, Fig. 6), defines the base of the Middle Members of the Aguelmous and Ouaoufilal (= Aoufital or Aoufilal) Formation in the Maïder and southern/eastern Tafilalt, respectively, but not in the central and northern Tafilalt. At M'karig, the regressive maximum is marked by subtidal sandstones with regular ripples (Fig. 12).

Step 9 may be expressed in the Dra Valley by the return of brachiopod-rich sandstones in

the upper Maader Talmout Member of the Tazout Formation (= upper Tazout 2). In the Meseta, it is recognizable at the base of HSS equivalents in the Oulmes region (base of Upper Member of Ta'arraft Formation, KAISER et al. 2007) and possibly at the base of the Jebel Akala Quartzites in the Sidi Bettache Basin. In other regions (El Hamman Zone, Ben Slimane, Khatouat), the identification of HSS equivalents is not yet supported by palynostratigraphy but there is potential to identify Step 9.



Fig. 12. Regular current ripples on the top surface of Bed 34 at M'karig (HSS equivalent), local base of Middle Member of the Ouaoufilal Formation).

Step 8. Biodiversity acme in neritic realm

Step 8 refers to the rich neritic fauna from supposed HSS levels (Middle Crisis Interval II) in the Ardennes (base of basal bed of the Hastière Formation). This correlates with the Middle Members of the Aguelmous and Ouaoufilal Formations, which yielded *Centrorhynchus?* as a regionally common hold-over taxon. The contemporaneous fauna from Lalla Mimouna (BECKER et al. 2011, 2012) is not yet fully explored. The corresponding Upper Brachiopod Fauna of the Western Dra Valley (Kheneg Lakahal, BRICE et al. 2007) is characterized by newcomers (see Step 11). HSS equivalents of the Oulmes region (KAISER et al. 2007) are unfossiliferous.

Step 7. Tener Event (sensu PRESTIANNI et al. 2016)

Not recognizable due to the poor palynological DCB research in Morocco.

Step 6. Geochronological dating II and beginning of Hangenberg Regression or Hangenberg Shale (base of Middle Crisis Interval I)

There are no Moroccan geochronological data but the onset of HS equivalents, as a close approximate of Step 6, is well recognizable throughout the Maïder, southern, and eastern Tafilalt. The change from black shale to grey-greenish shale is also recognizable at Ain Jemaa in the Oulmes region (KAISER et al. 2007, Fig. 2), perhaps also in the Foum-el-Mejez region of the Rehamna (Unit 5 of HOLLARD et al. 1982).

Step 5. Last occurrence of placoderms

Placoderms are abundant and partly very large-sized (e.g. the supposedly megaplanktivorous *Titanichthys*, COATHAM et al. 2020; Fig. 13) in the middle/upper Famennian pelagic platform and basin facies of the Eastern Anti-Atlas. However, it is surprising that not a single bone has been recovered so far from Wocklum-level strata (uppermost Famennian). Chondrichthyans (GREIF et al. 2022) and other fishes (KLUG & VALLON 2018) lived in the upper water column of anoxic HBS equivalents, but no placoderms. The eastern Anti-Atlas evidence suggests that placoderms declined considerably before Steps 2-3 and that they could not cope with HBS anoxia.



Fig. 13. Large (preserved length > 30 cm) lower jaw of the giant (up to 5 m long) placoderm *Titanichthys* from the upper part of the Mrakib Member (Ibaouane Formation, UD IV-C) at Mrakib, southern Maïder (leg. T. SÖTE, collection of the AG Paläontologie, Münster)

Step 4. Collapse of reefal environment

Not recognizable. There are no biostromes or reef builders in the uppermost Famennian of

Morocco, not even in shallow-water limestones, such as the Lower Lalla Mimouna Formation of the Maïder. The region was probably in a too high palaeolatitudinal position after the overall middle/upper Famennian cooling.



Fig. 14. Development of HBS equivalents as a distinctive orange-weathering shale band (from pyrite weathering to goethite/limonite), below greenish HS equivalents (basal Ouaoufil Formation, upper left) and above the beige-weathering nodular limestones at the top of the Erfoud Formation (ending just above the hammer); M'karig, easternmost Tafilalt.

Steps 2-3. Base of Hangenberg Black Shale and extinctions in the pelagic realm (base of Lower Crisis Interval)

HBS equivalents are well-developed in the Maïder Basin (Bou Tlidat Member of Ibaouene Formation, BECKER et al. 2018c), eastern parts of the Amessoui Syncline, and in the eastern Tafilalt, from M'fis to M'karig (Fig. 14). They are lacking at Lalla Mimouna, in the western Amessoui Syncline, and in the central and northern Tafilalt, as part of the significant unconformity at the top of the Erfoud Member, or due to erosion with the onset the Hangenberg Regression. The only known Meseta occurrence is at Ain Jemaa (Oulmes region).

Step 1. Geochronological age(s)

Not recognizable. The upper pre-crisis interval and crisis prelude are missing in many eastern Anti-Atlas successions due to non-deposition on the pelagic platforms with increasing shallowing, which may express a

first cooling phase pre-ceeding the HBS transgressive and thermal peak.

5. Summary

The data base for most Meseta successions is too poor to provide recommendations for a future DCB GSSP level but our review identified regions with potential for further research. In the eastern Abnti-Atlas, Steps 2-3, 6, 9, and 13 would be suitable for precise correlations, while Step 10 is a diffuse interval that is not really providing an isochronous time line.

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Lower Devonian sequence and Silurian–Devonian boundary in northern Xinjiang, NW China: a preliminary study

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1. Introduction

Affected by the Caledonian Orogeny, the Lower Devonian sequence in most areas of China is incomplete or even missing (HOU & WANG 1988). With the exception of some members of the *Uncinatograptus uniformis uniformis* graptolite zone (lowest Lochkovian) found in a few sections (CHEN et al. 2015), it is unclear whether the Silurian–Devonian boundary (SDB) exists in the rest of the vast area and its exact position remains unknown. The first appearance datum (FAD) of the conodont *Caudicriodus woschmidti*, which served as an auxiliary indicator of the bottom boundary of the Devonian system in the past, was used as the marker of the beginning of the Devonian system in certain carbonate sections in China. However, the FAD of true *C. woschmidti* is above that of *C. postwoschmidti*, and above the current SDB (CARLS et al. 2007). Therefore, whether *C. woschmidti* in these sections from China in the past can be used as an identification marker of the Devonian base and the first conodont zone of the Devonian remains to be further studied (QIE et al. 2019).

The Junggar area in northern Xinjiang is an important component of the Central Asian Orogenic Belt, known for its extensive Devonian and Carboniferous strata. The Lower Devonian was once considered as an important potential horizon for searching for the SDB in China (HOU & WANG 1988). However, since the Lower Devonian is mainly composed of pyroclastic rocks and yielded very few plankton

in this area, after nearly half a century of research by many scholars, the location of the SDB was only roughly determined from benthic fauna (e.g. corals, brachiopods) and a few graptolites (HOU et al. 1979; WANG 1991; XIAO et al. 1992; CAI et al. 1993; NI et al. 1998). Starting in 2021, we conducted a new survey of the Lower Devonian sequence around the Junggar Basin, and obtained valuable conodonts from limestone or calcareous siltstone interlayers or lenses within the pyroclastic rocks. The purpose of this study is to discuss the stratigraphic sequence and age of the Lower Devonian in the study area, as well as the location of SDB.

2. Lower Devonian Sequence

The Lower Devonian in northern Xinjiang is primarily found in the Altay and North Junggar subregions. The Lower Devonian in the Altay subregion consists of mostly metamorphic rocks with very few fossils (Fig. 1). In the North Junggar subregion, the Lower Devonian exhibits diverse sedimentary types and clear stratigraphic sequences, and has yielded abundant fossils. Lower Devonian rocks appear in five different “microregions” (Fig. 1).

2.1. Mayili Mountains “microregion”

The Lower Devonian is composed solely of the Malasu Formation, which is exposed in the Emin and Toli areas. It is a set of shallow marine pyroclastic rock and volcanic rock assemblages, with a significant thickness (reaching over 4000 m), and contains fossiliferous calcareous sandstone or limestone lenses locally. The Lower Devonian has no direct contact with the underlying Silurian strata, but is conformably overlain by the Middle Devonian Kulumudi Formation.

2.2. Shaerbuerti Mountains “microregion”

The Lower Devonian comprises the Wutubulake, Mangeer, and Mankelu formations in ascending order (Figs. 2A, D). Additionally, the Wutubulake Formation contains a portion of Silurian deposits. It is

primarily composed of fine-grained pyroclastic rocks in turbidite facies, intercalated with thick-bedded, coarse-grained pyroclastic rocks and a small amount of calcareous siltstone, with bioclastic or sandy limestone lenses (or thin layers) in the upper part. The lower part of the Mangeer Formation consists of coarse pyroclastic rocks, commonly intercalated with thin-bedded calcareous sandstone and bioclastic limestone. In the upper part of the Mangeer Formation, the granularity of the pyroclastic rocks is slightly finer and the calcium content is

increased, with bioclastic limestone and sandy limestone being thicker and more abundant, and reef limestone formed locally. The Mangkelu Formation consists of thin- to middle-bedded bioclastic limestone and sandy limestone intercalated with calcareous siltstone. Three formations are internally continuous and are conformably underlain by the Silurian strata and overlain by the Middle Devonian. They are the most continuous and complete Lower Devonian sequence found in northern Xinjiang to date.

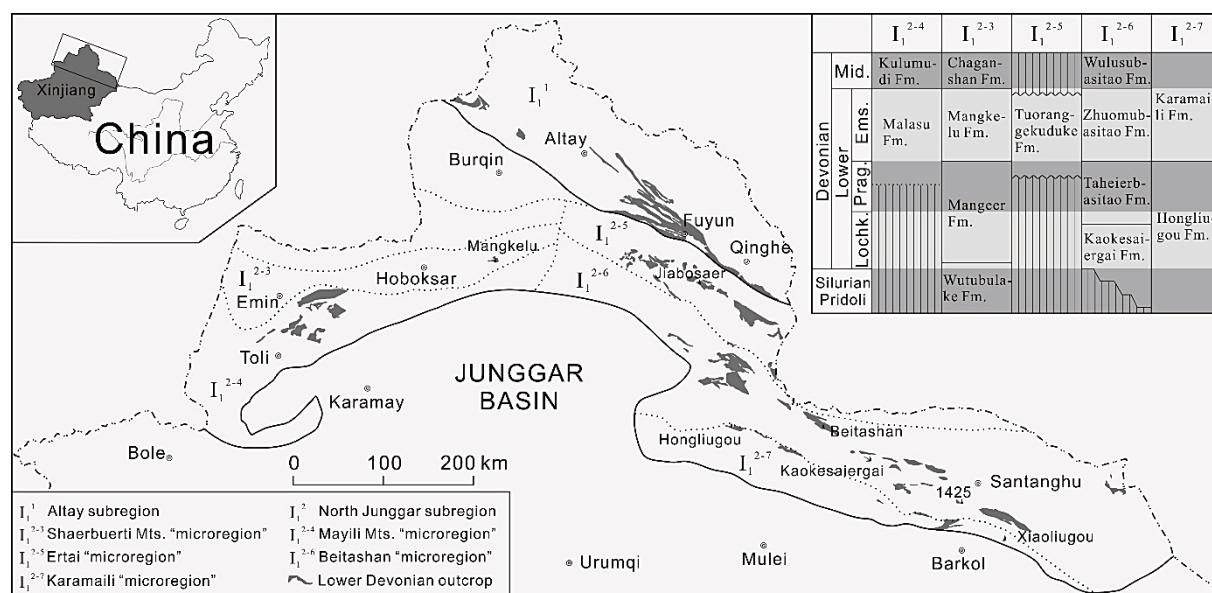


Fig. 1. Distribution and classification of the Lower Devonian strata in northern Xinjiang, NW China.

2.3. Ertai “microregion”

The Lower Devonian only includes the Tuoranggekudu Fm., which is distributed in the south of Fuyun and on both sides of the Ulungur River, extending southeast into Mongolia. It is a set of grayish yellow and yellowish green pyroclastic rocks with a small amount of volcanites and bioclastic limestone (Fig. 2C). It is unconformably underlain by the Ordovician and overlain by the Middle Devonian.

2.4. Beitashan “microregion”

Lower Devonian strata have regionally a wide distribution, stretching from the eastern edge of the Junggar Basin through Beitashan to Santanghu, and were named as different

lithostratigraphic units in various regional geological survey reports in the past. In this work, the formations from the bottom up were revised to consist of the Kaokesaiergai, Taheiherbasitao, and Zhuomubasitao formations. They are primarily composed of pyroclastic rocks. The Kaokesaiergai and Zhuomubasitao formations contain multiple layers of bioclastic limestone, sandy limestone, or calcareous siltstone or sandstone (Figs. 2E, G, H). The Taiheiherbasitao and Zhuomubasitao formations are widely distributed, while the Kaokesaiergai Formation is only found in the Kaokesaiergai Mountains and at Santanghu. The base of the Kaokesaiergai Formation is diachronous, ranging in age from the Pridoli to the Lochkovian.

2.5. Karamaili “microregion”

The Lower Devonian includes the Hongliugou Formation and the lower part of the Karamaili Formation, mainly distributed on the south side of the Karamaili Fault; the former is also scattered in the Barkol area. The Hongliugou Formation is composed of greyish purple and grayish green, fine pyroclastic and siliceous rocks, with bioclastic limestone or thin sandy limestone layers or lenses in the lower part (Figs. 2B, F). The lower part of the Karamaili Formation consists of grayish green pyroclastic rock with a small amount of calcareous clastic rock lenses. The Hongliugou Formation is conformably overlying the *Tuvaella*-bearing Baishanbao Formation (probably belonging to the Wenlock Series).

3. New conodont material and the Silurian–Devonian boundary

Except for the Karamaili Formation, conodonts were found in all the Lower Devonian stratigraphic units in the five “microregions”. However, there are no Lochkovian conodonts in the Malasu and Tuoranggekudu formations. The ages of two formations may be Emsian or Pragian–Emsian, which is consistent with the ages of the benthic fauna. This indicates that the Lower Devonian sequence of the Mayili Mts. and Ertai “microregions” are incomplete, and there is no Silurian–Devonian boundary there.

The Wutubulake Formation is the focus of the study of the SDB in northern Xinjiang. In the past, according to the benthic fauna and a few graptolites from the Mangkelu section, different scholars have located the SDB at the bottom, inside, or on top of the Wutubulake Formation (HOU et al. 1979; WANG 1991; XIAO et al. 1992). Currently, it is generally accepted that the entire Wutubulake Formation is classified as Pridoli based on the age of graptolites (CAI et al. 1993; NI et al. 1998). However, the discovery of *Caudicriodus hesperius* in the upper part of the Wutubulake

Formation in the Mangkelu section indicates that it contains at least a portion of Devonian deposits. In an adjacent new section of the Wutubulake Formation, successive conodont samples indicate that the distance between the final position of the Silurian conodont *Belodella anomalis* and the FAD of the Devonian conodont *Caudicriodus* sp. is less than 20 meters, indicating that the SDB is located within this range. The final appearance datum of encrinurid trilobites and the horizon of scyphocrinoid loboliths (Fig. 2I) in this section are both located in the first conodont zone of the Lochkovian (ZONG & GONG 2020; MA et al. 2023). At least in northern Xinjiang, these two fossils can be used as important auxiliary markers in the search for the SDB.

The Kaokesaiergai Formation was initially believed to be the upper Silurian based on the benthos. However, the discovery of the earliest Devonian conodont *Caudicriodus hesperius* (Fig. 2L) in the limestone near the base of this formation at Kaokesaiergai Mountains (where the stratotype section is located) has led to a re-evaluation (YIN et al. 2023). Unfortunately, below this fossiliferous limestone, there is the basal conglomerate. Below the basal conglomerate, there are either Ordovician pyroclastic or Silurian magmatic rocks, and Silurian conodonts are not present in this area. Southeastward to the 1425 section of Santanghu, the Kaokesaiergai Formation (formerly known as the Asushan Formation) has been entirely assigned to the Pridoli based on graptolites (NI et al. 1998). In this work, we also found graptolites from the *Uncinatograptus bouceki* zone at the bottom of this formation, i.e., *Uncinatograptus beatus*, *U. prognatus*, and *?U. nimius*. Moreover, the Lower Devonian conodont *Caudicriodus* cf. *hesperius* was found in the limestone lens approximately 15 m above the graptolite horizon, indicating the presence of the SDB in the Kaokesaiergai Formation in this section.

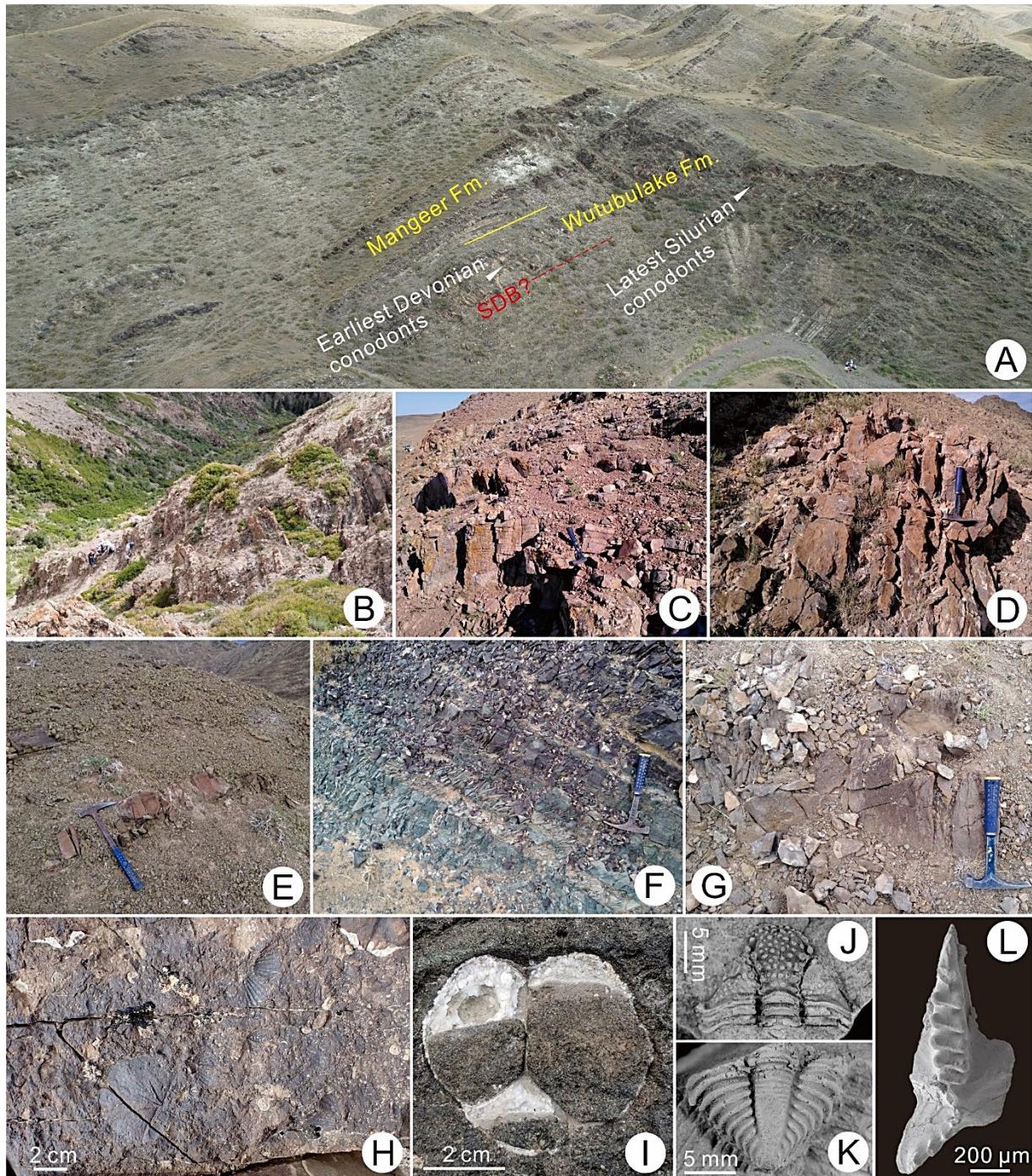


Fig. 2. Lower Devonian strata and fossils in northern Xinjiang, NW China. **A.** Outcrop of Wutubulake and Mangeer formations in the Mangkelu area and the Silurian–Devonian boundary determined by conodonts; **B.** Limestone outcrop of the lower part of the Hongliugou Formation in the Xiaoliugou section, Barkol; **C.** Bioclastic limestone from the Tuoranggekuduke Formation in the Jiabosaer section, Fuyun; **D.** Thin-bedded limestone from the Mangkelu Formation in the Mangkelu area; **E.** Fine pyroclastic rocks containing rust-colored, calcareous siltstone lenses from the Kaokesaiergai Formation in the 1425 section, Santanghu; **F.** Greyish green, greyish purple tuffite from the upper part of the Hongliugou Formation in the Hongliugou section; **G.** *Caudicriodus hesperius*-bearing limestone from the Kaokesaiergai Formation in the Kaokesaiergai Mts.; **H.** Fossiliferous calcareous sandstone from the Zhuomubasitao Formation in the Kaokesaiergai Mts.; **I.** Scyphocrinoid lobolith from the bottom of the Manger Formation in the Mangkelu area; **J, K.** Encrinurid trilobite *Batocara* sp. from the same horizon as *Caudicriodus* cf. *hesperius* in the 1425 section; **L.** *Caudicriodus hesperius* from the Kaokesaiergai Formation in the Kaokesaiergai Mts.

There were corals, brachiopods, and trilobites in the Hongliugou Formation, which were once dated as upper Silurian to Lower Devonian. A very small number of Lower Devonian conodonts (*Latericriodus* sp.) were found in a limestone in the lower Hongliugou Formation, while no Silurian conodonts were obtained. However, it is in conformable contact with the underlying Baishanbao Formation, which contains the *Tuvaella* fauna. Therefore, the presence of upper Silurian deposits in the Hongliugou Formation cannot be excluded.

In summary, although the Lower Devonian is widely distributed in northern Xinjiang, only a few sections have Lochkovian sequences. These are primarily composed of pyroclastic rocks, with limestone appearing as thin interlayers or lenses. The use of conodont biostratigraphy to determine the ages is challenging. However, the approximate position of the SDB can still be identified in certain relatively continuous sections. In addition, in pyroclastic areas, where conodonts or graptolites are absent, encrinurids (Figs. 2J, K) and loboliths (Fig. 2I) can also serve as markers for a preliminary SDB identification.

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Middle Devonian ostracods from the Jiwozhai patch reef in Dushan, Guizhou, South China

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Ostracoda are a common component in some Devonian reefs, which is significant for the understanding of evolutionary, palaeoecological, and palaeogeographic patterns of marine animals in deep time (KIESLING 2009). During the Middle Devonian, metazoan reefs reached an acme of the entire Phanerozoic (COPPER 2002; COPPER & SCOTESE 2003; HUANG et al. 2020), which mainly consist of stromatoporoids and corals, as well as other benthic organisms. In South China, Middle Devonian reef complexes are widespread in Yunnan, southern Guizhou, Guangxi and Hunan provinces, creating a reef belt that extended over 1.700 km (WU et al. 2010). However, despite ostracods being important reef-dwellers of Devonian reefs in South China, detailed studies on them are lacking. In this contribution, we first describe ostracod assemblages from the Jiwozhai patch reef in Dushan, southern Guizhou (Fig. 1B), and discuss their palaeoecological value.

For detailed and comprehensive studies on the Jiwozhai patch reefs, twenty-eight quadrats (0.5 m × 0.5 m), occupying 7 m² in total, were selected from the vertical section of the patch reef (HUANG et al. 2020; Fig. 1C). We collected 22 samples, each weighing approximately 1 kg. Finally, 29 species belonging to 20 genera were recognized (Tab. 1, Fig. 2). The ostracod assemblage consists of Podocopida (14 species belonging to 8 genera), Palaeocopida (8 species belonging to 7 genera), Platycopida (6 species

belonging to 4 genera), and Metacopida (1 species belonging to 1 genera).

Ecological implications

The entire ostracod assemblage from the Jiwozhai patch reef includes only neritic, benthic forms. They are abundant in the samples collected; for example, over 100 specimens were obtained from samples JWZ8-9, JWZ18, and JWZ19 (Fig. 1C). Samples are dominated by podopids (about 48 % of the total number of species), palaeocopids (28%), and platycopids (21%). Metacopids are the least diverse (one species = 3 %; Tab. 1). Thus, the ostracod assemblages belong to the smooth-podocopid association (WANG 1998). This is ecologically equivalent to the Eifelian Mega-Assemblage III, which is generally characterized by a diverse ostracod fauna including podopids, metacopids, palaeocopids, and platycopids (BANDEL & BECKER 1975; CASIER 2004, 2008). The abundance of reefal organism debris and the presence of large-sized, thick-shelled ostracods, such as *Samarella* POLENOVA, 1952, *Rectobairdia dushanensis* (SHI, 1964), and *Bairdiocypris cf. marginata* ADAMCZAK, 1976, suggest a shallow environment. The diversity of ostracod species, representative of the Eifelian Assemblage III, along with the richness of associated benthic macro- and microfaunas, such as stromatoporoids, corals (e.g. rugose and tabulate corals), and brachiopods (see details in HUANG et al. 2020) are indicative of a shallow open-marine environment.

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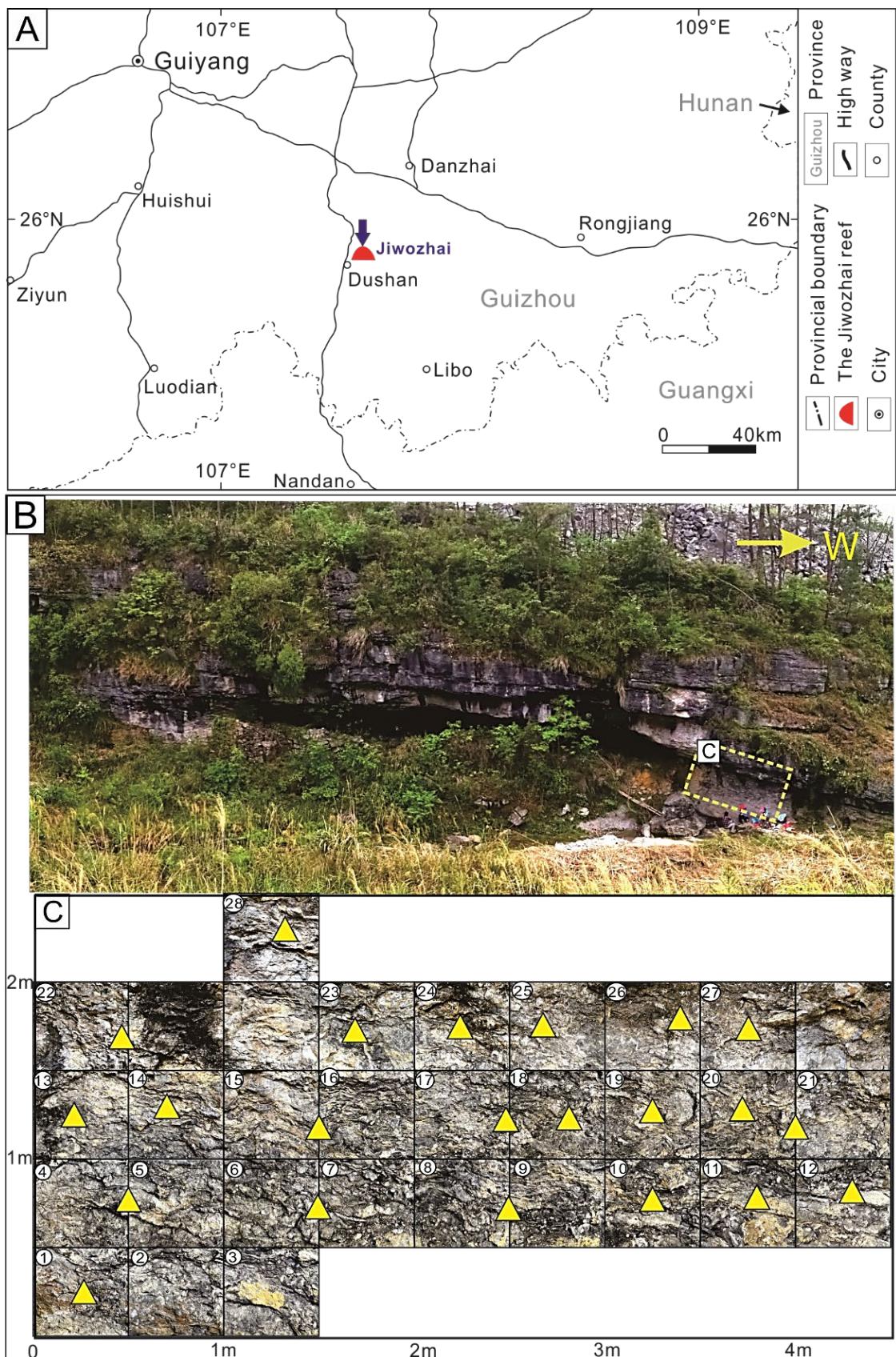


Fig 1. A. Location of the Dushan section in South China; **B.** General view of the patch reef, with a yellow rectangle showing the studied patch reef; **C.** Enlarged field photo of the rectangular area in (B), showing the 28 studied quadrats and their sampling positions (yellow triangles).

Order	Species	Period	Occurrences
Palaeocopida	<i>Aparchites auriculiferus</i>	D ₂	South Ural; Alberta, Canada; South China
	<i>Paraparchites subcircularis</i>	D ₂ –D ₃	South China
	<i>Samarella cf. reversa</i>	D ₂	South Ural; South China
	<i>Samarella</i> sp.		
	<i>Yingtangia suboblonga</i>	D ₂	South China
	<i>Parasargentina</i> sp.		
	<i>Svislinella ertangensis</i>	D ₁ –D ₂	South China
	<i>Roundyella reticulata</i>	D ₂ –D ₃	South China
	<i>Poloniella claviformis</i>	D ₂ (Giv.)	Germany, Poland; Belgium
	<i>Poloniella cf. cuneata</i>	D ₂ (Giv.)	Germany, Poland; Belgium
Platycopida	<i>Knoxiella sichuanensis</i>	D ₂ –D ₃	South China
	<i>Quasiknoxina</i> sp.		
	<i>Cavellina obesa</i>	D ₂	South China
	<i>Cavellina cf. obesa</i>	D ₂	South China
	<i>Bairdia cestriensis</i>	D ₂ –C ₁	America; South China; Tibet
	<i>Bairdia plicatula</i>	D ₂ (Giv.)	Russia; South China
	<i>Bairdia cf. paraproba</i>	D ₁ –D ₂	South China
	<i>Bairdia cf. hisingeriformis</i>	D ₂ –C ₁	Russia
	<i>Rectbairdia dushanensis</i>	D ₂ –D ₃	South China; Tibet
	<i>Silus parallelus</i>	D ₂ (Giv.)	South China
Podocopida	<i>Silus cf. parallelus</i>	D ₂ (Giv.)	South China
	<i>Microcheilinella subinfradomanica</i>	D ₂	South China
	<i>Microcheilinella cf. lufengshanensis</i>	D ₂	South China
	<i>Microcheilinella cf. infradomanica</i>	D ₂ (Giv.)	South Ural; South China
	<i>Poniklacella</i> sp.		
	<i>Bairdiocypris cf. marginata</i>	D ₂	Poland; France
	<i>Healdianella</i> sp.		
	<i>Wangshangkia</i> sp.		
	<i>Baschkirella cf. longa</i>	D ₂	Russia; South China
Metacopida			

Tab. 1. Ostracod species data from the Jiwozhai patch reef (D₁= Early Devonian; D₂= Middle Devonian; D₃= Late Devonian; C₁= Early Carboniferous; Giv.=Givetian).

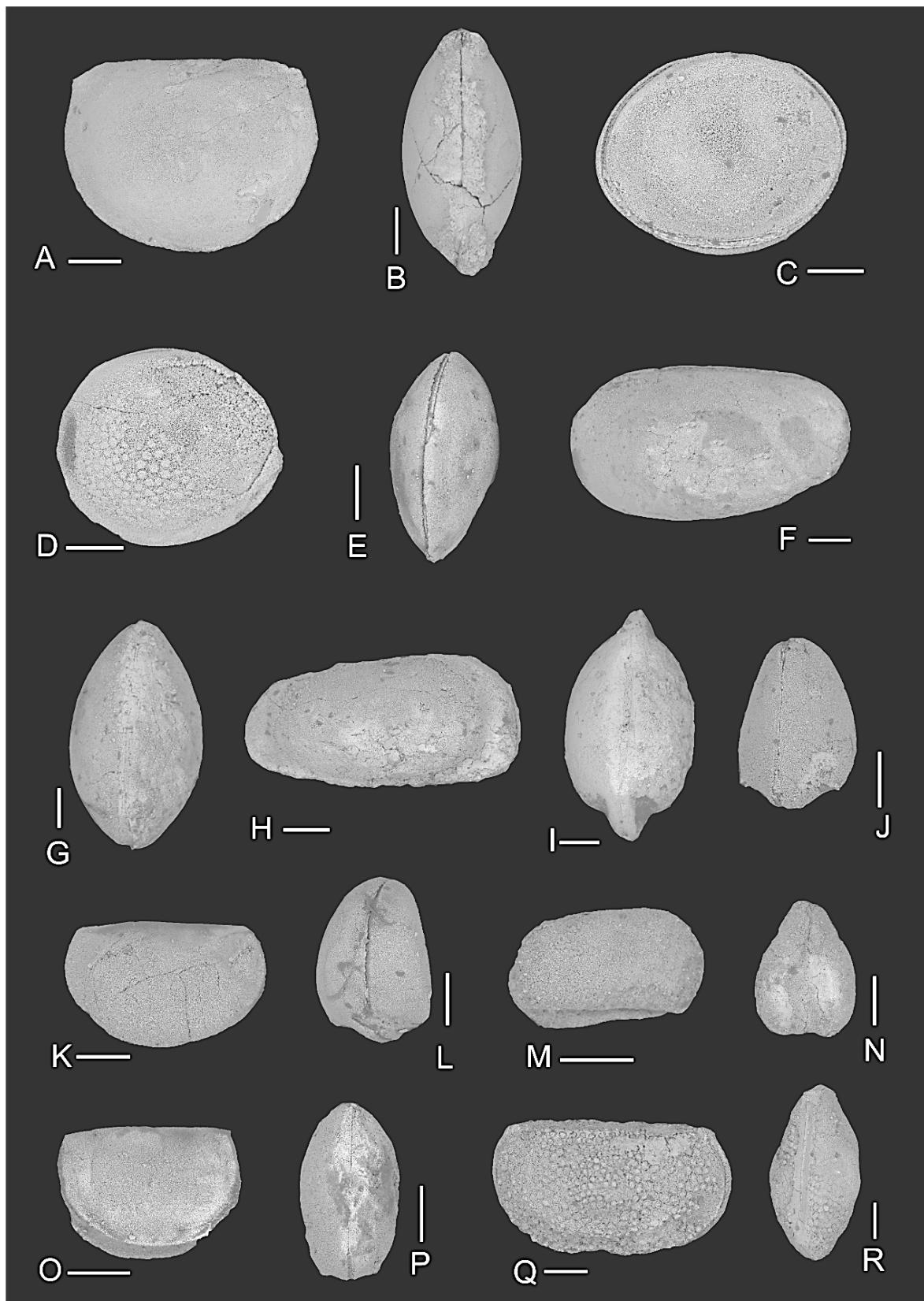


Fig. 2. Common ostracod species from the Jiwozhai patch reef in Dushan, South China; scale bar = 200 μm . A. *Aparachites auriculiferus* ROZHDESTVENSKAYA, 1960, right lateral view of complete carapace, JW2023001; B. *Aparachites auriculiferus* ROZHDESTVENSKAYA, 1960, dorsal view of complete carapace, JW2023002; C. *Paraparachites subcircularis* (WANG & SHI, 1982), right lateral view of complete carapace, JW2023003; D. *Paraparachites subcircularis* (WANG & SHI, 1982), left lateral view of complete carapace, JW2023004; E.

Paraparchites subcircularis (WANG & SHI, 1982), dorsal view of complete carapace, JW2023005; **F.** *Samarella* cf. *reversa* (POLENOVA, 1955), left lateral view of complete carapace, JW2023006; **G.** *Samarella* cf. *reversa* (POLENOVA, 1955), dorsal view of complete carapace, JW2023007; **H.** *Samarella* sp., right lateral view of complete carapace, JW2023008; **I.** *Samarella* sp., dorsal view of complete carapace, JW2023009; **J.** *Yingtangia suboblonga* WANG, 1979, dorsal view of complete carapace, JW2023010; **K.** *Yingtangia suboblonga* WANG, 1979, right lateral view of complete carapace, JW2023011; **L.** *Yingtangia suboblonga* WANG, 1979, ventral view of complete carapace, JW2023012; **M.** *Parasargentina* sp., right lateral view of complete carapace, JW2023013; **N.** *Parasargentina* sp., dorsal view of complete carapace, JW2023014; **O.** *Svislinella ertangensis* WANG, 1979, right lateral view of complete carapace, JW2023015; **P.** *Svislinella ertangensis* WANG, 1979, dorsal view of complete carapace, JW2023016; **Q.** *Roundyella reticulata* WEI, 1988, right lateral view of complete carapace, JW2023017; **R.** *Roundyella reticulata* WEI, 1988, dorsal view of complete carapace, JW2023018.

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WANG, Y.-J., WANG, Y., MA, J.-X., LUO, M. & QIE W.-K. (2020). The Jiwozhai patch reef: A palaeobiodiversity hotspot in middle Givetian (Devonian) of South China. - Palaeogeography, Palaeoclimatology, Palaeoecology, **556** (109895): 16 pp.

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DEVONIAN MEETINGS



Traditionally, ICS subcommissions were asked to hold meetings at the IGCs – the next in 2024 will be held in Busan, South Korea. For details go to the homepage (www.igc2024korea.org) or to the 1st Circular. Topic T3 of the preliminary programme includes *Earth History and Stratigraphy*. There is an extensive excursion offer but none touches Devonian strata. In fact, the country is lacking Silurian and Devonian sedimentary rocks; there are only Devonian granites and metamorphites. For this reason, it is unlikely than many SDS members will find their way to Busan.

DEVONIAN PUBLICATIONS

New monograph series on the Devonian of New York

VER STRAETEN, C. A., OVER, D. J. & WOODROW, D. (eds., 2023). Devonian of New York, Volume 1: Introduction and Přídolí to Lower Givetian (Upper Silurian to Middle Devonian) Stages. – Bulletins of American Paleontology, **403/404**: 1-280; doi:10.32857/bap.2023.403.01-06.

Bulletins of American Paleontology

Published since 1895 Numbers 403–404, July 2023

**Devonian of New York, Volume 1:
Introduction and Přídolí to Lower Givetian
(Upper Silurian to Middle Devonian) Stages**

Edited by:
Charles A. Ver Straeten, D. Jeffrey Over, and
Donald Woodrow

PALEONTOLOGICAL RESEARCH INSTITUTION

Content:

VER STRAETEN, C. A. Dedication to Dr. Lawrence (Larry) V. RICKARDS. – pp. 1-5.

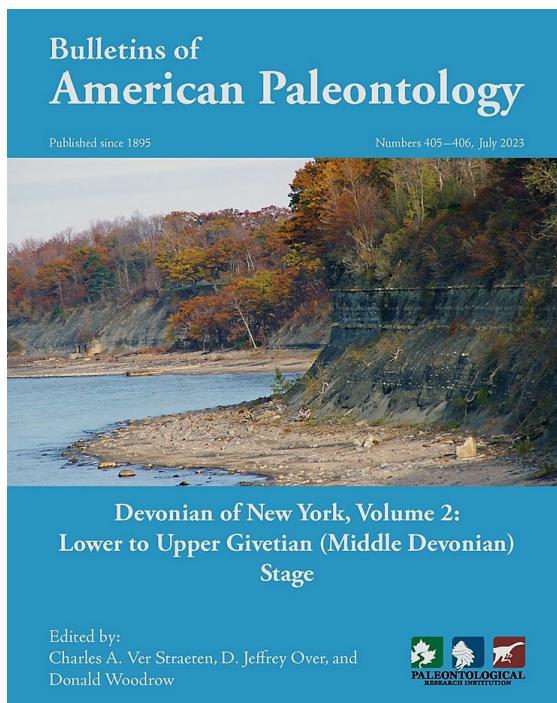
VER STRAETEN, C. A. Chapter 1: An introduction to the Devonian Period and the Devonian in New York State and North America. – pp. 11-102.

EBERT, J. R. & MATTESEN, D. K. Chapter 2: Lithostratigraphy, multi-taxa biostratigraphy, and sequence stratigraphy of the Helderberg Group (Přídolí-Lochkovian) in New York State. – pp. 103-151.

VER STRAETEN, C. A. Chapter 3: The Port Jervis, Oriskany, Esopus, and Schoharie formations, and equivalents: Pragian and Emsian strata of New York. – pp. 153-204.

VER STRAETEN, C. A., BRETT, C. E., BAIRD, G. C., BARTHOLOMEW, A. J. & OVER, D. J. Chapter 4: Lower Middle Devonian (Eifelian-lower Givetian) strata of New York State: The Onondaga Formation and Marcellus Subgroup. – pp. 205-280.

VER STRAETEN, C. A., OVER, D. J. & WOODROW, D. (eds., 2023). Devonian of New York, Volume 2: Lower to Upper Givetian (Middle Devonian) Stage. – Bulletins of American Paleontology, **405/406**: 1-378; doi:10.32857/bap.2023.405.01-03.



Content:

BRETT, C. E., BAIRD, G. C., ZAMBITO IV, J. J. & BARTHOLOMEW, A. J. Chapter 1: Stratigraphy and facies of the middle and upper Hamilton Group (Middle Devonian; Givetian) in New York State and adjacent areas. – pp. 1-195.

BARTHOLOMEW, A. J. & VER STRAETEN, C. A. Chapter 2: Marine strata of the middle to upper Hamilton Group (Middle Devonian, lower Givetian), eastern outcrop belt in New York State. – pp. 197-258.

BAIRD, G. C., ZAMBITO IV, J. J. & BRETT, C. E. Chapter 3: Tully Formation and pre-Frasnian Genesee Group succession. – pp. 259-378.

VER STRAETEN, C. A., OVER, D. J. & WOODROW, D. (eds., 2023). Devonian of New York, Volume 3: Frasnian and Famennian (Upper Devonian)

Stages and the Devonian Terrestrial System in New York. – Bulletins of American Paleontology, **407/408**: 1-330; doi:10.32857/bap.2023.405.01-05.

Content:

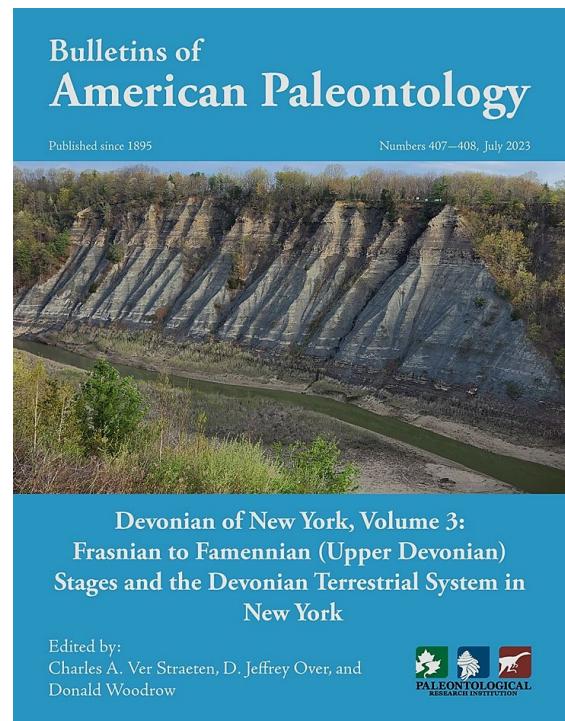
OVER, D. J., BAIRD, G. C. & KIRCHGASSER, W. T. Chapter 1: The Frasnian strata-lower Upper Devonian of New York State. – pp. 1-28.

BUSH, A. M., BEARD, A., BRISSON, S. K., PIER, J. Q. & HREN, M. T. Chapter 2: Stratigraphy of the Frasnian-Famennian boundary interval in shallow-marine paleoenvironments of New York and north-central Pennsylvania (Wicoy-Caneadea formation, Upper Devonian). – pp. 29-46.

SMITH, G. J. & JACOBI, R. D. Chapter 3: Upper Frasnian and Famennian stratigraphy in western New York State. – pp. 47-111.

BAIRD, G. C., HARPER, J. A., OVER, D. J., HANNIBAL, J. T., MCKENZIE, S. C. & TESMER, I. H. Chapter 4: Late Famennian Conneaut Group to basal Mississippian stratigraphic succession and geochronology, New York/Pennsylvania borderland and Lake Erie region. – pp. 113-209.

VER STRAETEN, C. A. Chapter 5: The Devonian terrestrial system of New York. – pp. 211-330.



The volumes are a “must have” for Devonian stratigrapher’s or their libraries. They can be

ordered via the homepage of the Paleontological Research Institute (PRI), Ithaca, New York State:

<https://www.priweb.org/research-and-collections/bulletins-of-american-paleontology>:

The full set is 200 US \$, single volumes (not really recommended) 80 US \$ (prices without shipping).

GSA Connects 2022 Meeting in Denver, Colorado, Devonian abstracts

Published as Geological Society of America, Abstracts with Programs, **54** (5). For access see: <https://gsa.confex.com/gsa/2022AM/webprogram/start.html#srch=words%7CDevonian%7Cmethod%7Cand%7Cpge%7C1>.

AVILA, T., SALTZMAN, M., GRIFFITH, E. M. & JOACHIMSKI, M. M. The interaction between silicate weathering and climate change in the Devonian. – Paper No. 223-15.

CARTER, E., CARBON, T. & BOYER, D. Evaluation of marine communities before and after the Late Devonian Biotic Crisis: Great Basin, USA. – Paper No. 133-3.

CHILCOAT, G., PIPPENGER, K. & COHEN, P. The Late Devonian Kellwasser Events in the Appalachian Basin: A synthesis of microfossil and geochemical data through space and time. – Paper No. 87-9.

COLE, E., LIU, X.-M. & SALTZMAN, M. Strontium ($^{87}\text{Sr}/^{86}\text{Sr}$) and lithium ($\delta^7\text{Li}$) isotopic evidence for shifts in Devonian weathering patterns: Implications for the expansion of land plants and the onset of the Acadian Orogeny. – Paper No. 80-7.

ECCLES, J., ORMAN, S., ANDERSON, L. C., VANTOORENBURG, H., BAUER, J. E. & SHEFFIELD, S. Examining morphological variation as a result of encrustation on *Paraspirifer* brachiopods. – Paper No. 242-2.

ELLEFSON, E., SPERLING, E., LESLIE, A., TARHAN, L., OLSON, H. & MANSON, M. Tracking the impact of land plants on Earth systems on the northwestern Laurentian margin. – Paper No. 273-30.

FRANK, T. & TREMBLAY, S. A mid-Devonian lagerstätte from the Catskills (New York, USA) reveals invertebrates from an early freshwater ecosystem. – Paper No. 63-20 [mostly arthropods].

GEIER IV, G., LOCKETT, A., MCCLELLAND, W., CONNORS, C., FAME, M. & STRAUSS, J. New insights into Devonian-Carboniferous geological relationships in the northeastern Brooks Range of Alaska. – Paper No. 135-2.

GORZELAK, P., KOLBUK, D., STOLARSKI, J., BACAL, P., DUDA, P., ŚRODEK, D., BRACHANIEC, T. & SALAMON, M. A diamond-like microlattice in the Devonian crinoids. – Paper No. 273-10.

HIGGINS, F., OVER, D. J., GIORGIS, S. & SLATER, B. Precession and sub-precession cycles within the Hannover Formation, Java Group, Upper Devonian, Western New York State. – Paper No. 99-1.

HU, M.-X., MYROW, P., FIKE, D. A., DI PASQUO, M., ZATOŃ, M., FISCHER, W. & COATES M. Depositional history of Devonian to lower Mississippian strata in northern Wyoming and southern Montana, USA. – Paper No. 249-4.

ILTAF, K. H., HU, Q.-H., OWARE, P., WANG, Q.-M., ZTHANG, T. & AWAN, R. S. Geochemical and petrophysical characteristics of the New Albany Shale in Indiana and Illinois. – Paper No. 234-2.

JORDAN, K. Phylogenetic and biogeographical patterns of proetid trilobites across the Devonian-Carboniferous boundary. – Paper N. 13-3 [entirely based on data analyses and statistics].

KABANOV, P., GOUWY, S., VAN DER BOON, A. & GRASBY, S. E. Nature of Devonian anoxic events based on multiproxy records from Panthalassian Domain, NW Canada. – Paper No. 259-4.

KERR, J., PIER, J. Q., BRISSON, S. K. & BUSH, A. Environmental limitations on settling locations of Late Devonian skeletobionts in the Appalachian Basin. – Paper No. 63-2.

LASEMI, Y. Stratigraphic framework and depositional system of the Middle Devonian Lingle Formation, Illinois Basin. – Paper No. 249-9.

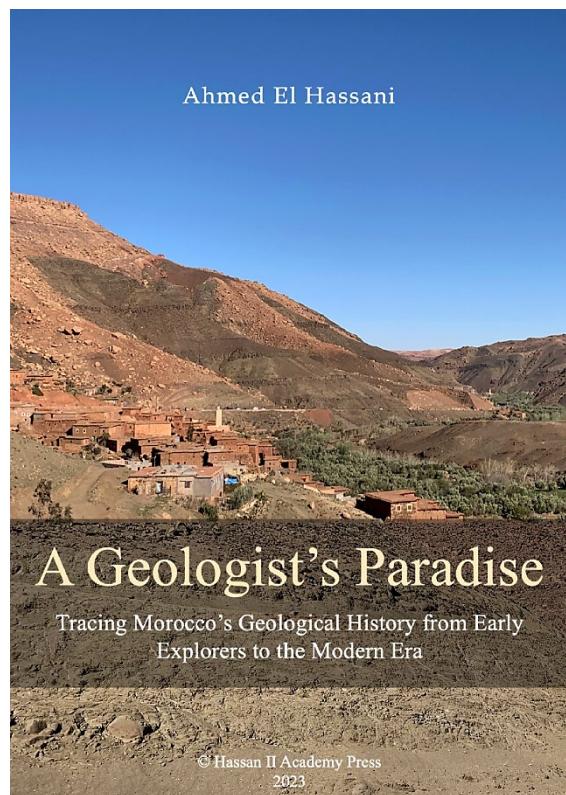
MAJCHRZYK, A., JAKUBOWICZ, M. & ZAPALSKI, M. Is the present the key to the past? Paleoecology of a Middle Devonian reef community from Madene el Mrakib (Anti-Atlas, Morocco). – Paper No. 214-2.

MARSHALL, M. S. Incised valley depositional sequence and root traces of the Late Devonian (Frasnian) Temple Butte Formation in Marble Canyon, eastern Grand Canyon. – Paper No. 191-2.

MCADAMS, N., DAY, J., FIORITO, A. & MORGAN, D. Integrated conodont, $\delta^{13}\text{C}$, trace element, and sequence stratigraphic analysis of Givetian-Frasnian

- boundary interval in Iowa and Nevada, USA. – Paper No. 273-31.
- MCGLANNAN, A., BONAR, A., STENIG, S., VALDES, P. J., PFEIFER, L. S., ADAMS, S., DUARTE, D., MILAD, B., CULLEN, A. & SOREGHAN, G. Eolian dust sourced Devonian-Mississippian mudrocks of the greater North American midcontinent. – Paper No. 99-17.
- MOORE, T. E. Correlating the Endicott Mountains Allochthon, the Amawk Thrust, and the regional pre-Mississippian unconformity across the Mt. Doonerak Antiform into the central belt, Central Brooks Range, Alaska. – Paper No. 76-11 [suggesting a major sub-Frasnian unconformity].
- MUTTEL, S., SPOTLOE, T., WEISLOGEL, A., MCKAY, M., SCHAFLER, B. & PHILLIPS, S. Resolving Upper Paleozoic stratigraphy in eastern West Virginia through geologic mapping and detrital geochronology. – Paper No. 200-6 [mostly dealing with Upper Devonian clastic ages].
- PIPPENGER, K. & TARHAN, L. Characterizing bioturbation intensity and sedimentary mixed layer development in the Devonian of the Appalachian Basin. – Paper No. 228-5.
- SALAMON, M., BRACHANIEC, T., KOLBUK, D. & GORZELAK, P. Patterns of body size evolution in fossil crinoids. – Paper No. 273-9 [proposed body size reduction at the “Late Devonian extinction event”].
- SIME, J. & SALLAN, L. Exploring the role of transitions between fish and salt water in the macroevolution of ray-finned fishes (Actinopterygii). – Paper No. 119-4 [impact of the Hangenberg Crisis].
- SMITH, C., COLE, E. & HIBNER, B. Carbon and sulfur isotopes: Pairing proxies from carbonate rocks to constrain the timing of anoxia during the Late Devonian in the Great Basin region, USA. – Paper No. 168-5.
- VANDER PAS, B., GILHOOLY III, W., SMART, M., FILIPPELLI, G. M., MARSHALL, J. E. A. & WHITESIDE, J. H. Landscape evolution during the Middle Devonian: Evidence from an Old Red Sandstone lacustrine sequence. – Paper No. 168-3.
- VANTOORENBURG, H., ANDERSON, L. C., ECCLES, J., ORMAN, S., BAUER, J. E. & SHEFFIELD, S. Exploring the epibiont encrustation patterns: A case study with *Paraspirifer bowknockeri*. – Paper No. 242-1.
- WARREN, A. & JIANG, G.-Q. Microbialites associated with the Devonian-Carboniferous Boundary Hangenberg Event in the Western United States. – Paper No. 125-3.
- WELDON, A., ZAMBITO IV, J. & MC LAUGHLIN, P. Chemostratigraphy of the Middle-Upper Devonian Blocher Member (lowermost New Albany Shale) at Gallatin, Tennessee. – Paper No. 249-5.
- WELYCH-FLANAGAN, M. Biogenic carbonate $\delta^{18}\text{O}$ as a proxy for 10-100 ky scale paleoenvironmental variation during the Middle Devonian: A pilot study. – Paper No. 169-5.
- ZAMBITO IV, J. Stratigraphy and sedimentology of the Devonian Antrim Shale in the Schmucker 3-30 Core, Northwest Ohio. – Paper No. 244-7.

New book on the Geology of Morocco



[The cover photo shows an impressive pile of basaltic flows (GPS: 31°09'12" N; 07°27'03" W), located about 2 km downstream of Agouim and just past Tiourjdal (RN 9: Ouarzazate milestone 67 km), emplaced during the major event that characterized the Central Atlantic Magmatic Province (CAMP). This event is considered responsible for the biological crisis at the Triassic-Jurassic boundary. The main part of this lava flow pile is ~196 Ma (Hettangian-Sinemurian). This series is overlain by Liassic siltstones and carbonates, later overlain by Cretaceous layers.]

EL HASSANI, A. (2023). A Geologist's Paradise. Tracing Morocco's Geological History from Early Explorers to the Modern Era. – 382 pp; Rabat (Hassan II Academy Press); ISBN 978-9954-716-22-9.

Morocco's geology comprehensively illustrates the earth's history from the Archean era to the Quaternary period, making it a highly regarded country in this field. It has garnered significant attention from the global scientific community, and many geologists from diverse regions regularly visit the country. The geological terrains in Morocco are immensely varied and display magnificent landscapes. Furthermore, scientists have identified several stratotypes and fossil groups in Morocco, which they consider the most representative on a planetary scale. Unfortunately, most Moroccans, including natural area managers and non-specialized scientific communities, remain unaware of this rich geological heritage. Therefore, it is crucial to conduct inventory-based studies to increase public awareness about safeguarding, developing, and rationalizing this geological heritage. Regrettably, the commercial value of this natural heritage currently takes precedence, resulting in massive and even abusive exploitation of the mineral and fossil wealth, leading to their inevitable disappearance in the short or medium term.

Content:

- (i) **Geology evolution in Morocco: A Historical Overview from Early Explorations to 1968:**
 - The beginnings of geology in Morocco (1808 to 1900)
 - Moroccan geology's Explorers (from 1900)
 - Unraveling the Enigma of Morocco's "Caledonian orogeny"
 - Monographs and maps Era and Thematic Memoirs
- (ii) **Impacts of the Scientific Institute on the Earth Sciences' evolution**
 - Geology Takes Root at the "*Institut Scientifique Chérifien*"
 - The Creation and vocation of the Moroccan Scientific Institute
 - The ISC scientific output.
- (iii) **From Discovery to Understanding: The History of Morocco's Oldest Fossils**

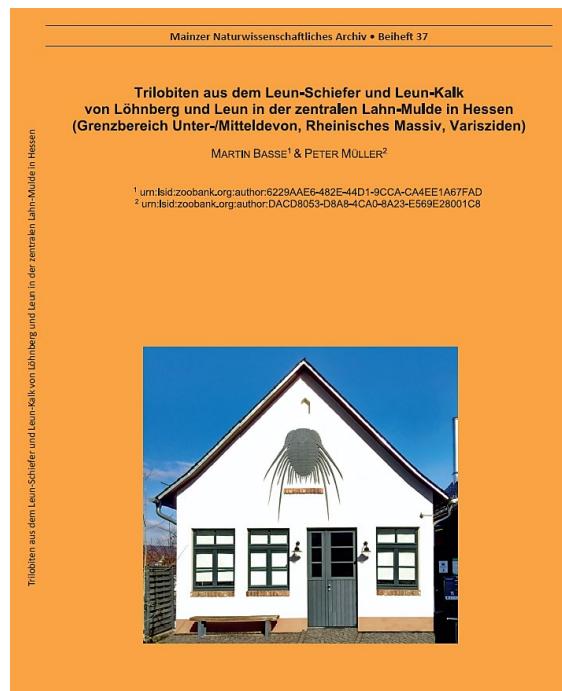
(iv) **Insights into the Geological Structure and Evolution in Morocco**

- Main Geological Features of Morocco
- Morocco is a mining country with several types of mineralization. The structural domains of Morocco.

(v) **Morocco's Geological Heritage, The Need for Inventory, Valorization, and Preservation.**

The book includes more than 220 illustrations of outcrops, fossils, maps, and stratigraphical charts. Chapter IV can be used as a Field Guide to the most important sites and includes numerous Devonian examples. The free volume is available on request, via our CM author, from the Hassan II Academy of Science and Technology.

New monograph on Trilobites from the Lower-Middle Devonian transition of the southern Rhenish Massif, Germany



[The cover shows the front of the Water Museum in Löhneberg, which houses a permanent exhibition of the fauna from the upper Emsian Leun Shale, exemplified by the large, simplified model of the spinose trilobite *Kettneraspis loehnbergensis* n. sp.].

BASSE, M. & MÜLLER, P. (2023). Trilobiten aus dem Leun-Schiefer und Leun-Kalk von Löhneberg und Leun in der zentralen Lahnmulde in Hessen (Grenzbereich Unter-

/Mitteldevon, Rheinisches Massiv, Varisziden).
 – Mainzer Naturwissenschaftliches Archiv,
 Beiheft, 37: 1-211; ISSN 0174-6626.

Abstract

Central and southern parts of the Lahn Syncline include autochthonous pelitic and carbonatic sedimentary rocks, often rich in trilobites, mainly of late Upper Emsian and Lower Eifelian ages. They originated in different sub-basins of the shelf of the Rhenohercynian Ocean of the East-Avalonia Terrane north of the Rheic Ocean. While Upper Emsian trilobites of those southern parts can meanwhile be regarded as well-investigated, central parts had hitherto yielded only sparse information. Around Löhnberg and Leun, villages in the central Lahn Syncline, Emsian/Eifelian boundary beds are developed as Leun Shale and Leun Limestone with trilobites as quantitatively dominant macrofauna. In the course of that Upper Emsian, poorly documented biofacially Rhenish faunas are replaced by Hercynian ones in an unknown way. For the central Lahn Syncline, the Hercynian record is shown by finds from Löhnberg and Leun. In a stratigraphically limited and lithologically appearingly uniform part of the late Upper Emsian Leun Shale of Löhnberg, 14 genera and at least 15 appearingly endemic species have been identified, the following new: *Diademaproetus frankschmidtii* n. sp., *Lahnops postmahrheckam* n. sp., *Rheicarges schneideri* n. g., n. sp., *Ceratocephala martinii* n. sp., *Koneprusia morrisoni* n. sp., *Kettneraspis loehnbergensis* n. sp., and *Leonaspis jdongesi* n. sp. Absence of the subfamily Proetinae and a rich odontopleurid fauna are noteworthy. The currently most similar fauna comes from the middle Rupbach Shale of the south-eastern Lahn Syncline.

Seven kilometers north to northeast of Löhnberg, near Leun, the Upper Emsian part of the Leun Limestone has yielded specifically appearingly endemic Hercynian faunas, 100% of the species of which differ from Löhnberg. This may have been triggered by facies differences. This fauna, which comes from different parts of that limestone, includes 27 genera and 14 taxa of the species group, including new taxa: *Diademaproetus holzapfeli ahrensi* n. ssp., *Diademaproetus? elevator* n. sp., *Ignoproetus bohatyi* n. sp., *Macroblepharum leunense* n. sp., *Orbitoproetus ager* n. sp., *Koneprusites lahnae* n. sp., *Phaetonellus nasiae* n. sp., *Tropidocoryphe hesseniana* n. sp., *Leunoculus leunensis* n. g., n. sp., and *Perunaspis mathesii* n. sp. There, proetines are well-documented, whereas odontopleurids are rare. In contrast, the Leun limestones of Lower Eifelian age have yielded significantly fewer genera and species, with the new *Thysanopeltis jhabenichti* n. sp.,

Chotecops ahlburgi n. sp., *Ch. Braunfelsensis* n. sp., and *Struveaspis liuunensis* n. sp.

These finds from Löhnberg and Leun represent associations of genera the majority of which are typical for parts of the Rheic Ocean between North Gondwana and East Avalonia. They are patching one of the last major gaps in knowledge about trilobites of the Lahn Syncline.

Greifenstein and Günterod sites of the Dill area: In addition to the documentation of faunal records of the central Lahn Syncline, the main focus herein lies on aspects of the question of their faunal relations with the tectonically complex Dill area immediately north of the Lahn Syncline. Related synchronous rocks are the Greifenstein Limestone of the Hörre Nappe, the Ballersbach and Günterod limestones of the Bicken-Ense Nappe, as well as the Wissenbach Shale of the Dill-Eder Syncline. Of special interest is the question whether the Greifenstein Limestone is part of the allochthonous Armorican Nappe, or if it should be regarded as a paraautochthonous element of the Rhenohercynian Nappe. Therefore, the present article also contributes to corresponding ongoing studies on the revision and record of Dill faunas by providing some faunal comparisons and illustrations, as well as descriptions of new taxa. These are *Koneprusites aarae* n. sp., *Aaraecoryphe hermanni* n. g., n. sp., *Struveaspis haigeriana* n. sp., *Ceratocephala greifensteinensis* n. sp., *Ce. hoerriana* n. sp., *Radiaspis guenterodensis* n. sp., and *Ra. knoppi* n. sp. All that new information will profoundly influence future investigations on palaeogeographic relationships within the Rheic Ocean.

Miscellanea: In the course of discussions on the odontopleurine *Radiaspis*, *Carnicaspis* n. g. from the Silurian of the Carnic Alps is established. *Branikarges*, new name, Trochurinae, is suggested as a new substitute name for the primary homonym *Lobopyge*.

This monograph is a “must have” for all Devonian trilobite workers and holds important new data concerning the stratigraphy in the southern Rhenish Massif. Its price is obviously low: 15 €. Try to order it by email from the Naturhistorisches Museum Mainz (see its homepage with an email address).

MEMBERSHIP NEWS

CM Markus ARETZ

Research in 2022-2023 focused on the Devonian can be divided into two main topics. The first is the revision of the Devonian-Carboniferous Boundary. The DCB Task Group has made major progress over the last two years, initiated by the wealth of data available after the publication of the special DCB volume published in *Palaeobiodiversity and Palaeoenvironments* in 2021. After a series of online meetings and discussions, we are now preparing the proposal for the new boundary criterion to be submitted for approval by SCCS before the end of the year. Results of this have been presented in Lille at STRATI 2023 in the session organized by the Carboniferous Subcommission. Before STRATI, a small group composed of Task Group members and local experts visited DCB boundary sections in Germany (Borkewehr, Becke-Oese, Dreher) and Belgium (Chaxhe, Royseux, Anseremme, Spontin, Chansin).

The second research topic is related to the evolution of Devonian reefs. I am currently co-supervising two Ph.D. projects; the first is by **Tanja UNGER** (Bochum), who works on exceptional exposures in the Klutert Cave of the northern Rhenish Massif, where a Givetian reef system developed in a sediment-stressed environment (siliciclastic Upper Honsel Formation). The second project is done by **Matthieu SAILLOL** (Toulouse), who works on the evolution of Lower Devonian reefs in several parts of France and in the Carnic Alps.

With Elise NARDIN (Toulouse), I continue to work on the Devonian of the Pyrenees and in the Minervois. In the latter region, we are currently studying with other colleagues the Devonian succession of Caunes-Minervois, which contains the widely known, Emsian-aged red *Stromatactis* Mounds.

Elise NARDIN, Frédéric CHRISTOPHOUL (Toulouse), Julien DENAYER (Liège), and myself have written a long chapter on Devonian and Carboniferous sedimentary basins for a book related

to the Variscan orogeny. This book should be available in French and English in the next weeks.

CM Gordon C. BAIRD

submitted additional Devonian geochronological samples to be curated through the Paleontological Research Institution, Ithaca, New York as part of an ongoing National Science Foundation grant supporting a digital curation effort (with Carlton E. BRETT and PRI. Staff, Ithaca). Information relating to 2,500 Middle and Upper Devonian rock and fossil samples from New York and adjacent states is being digitally upgraded through the entire period 08/21–10/23. It is anticipated that funding for this curation effort will continue into autumn 2023. This collection is now being housed in a new wing at PRI, the construction of which is now nearly complete. Parts of this collection were on view for SDS member participants of the IGCP 652 Annual Meeting, on *Devonian Stratigraphy of New York State*, held on 03 August, 2023.

Publications

For the several contributions to the new New York State Devonian monograph see the Devonian Publications section.

Guidebook publications, 2023 SDS meeting in Geneseo

BAIRD, G. C., HARPER, J. A., OVER, D. J., HANNIBAL, J. T. & MCKENZIE, S. C. (2023). Late Famennian to basal Mississippian stratigraphy in northern Ohio: reference section for the end-Devonian succession in the Lake Erie region. – In: OVER, D. J. (ed.), Upper Devonian Strata of the Northern Appalachian Basin, Field Trip 1 – 27-29 July, 2023, Pre-meeting Guidebook, Subcommission on Devonian Stratigraphy and IGCP 652, Reading Geologic Time in Paleozoic Sedimentary Rocks, Geneseo, New York: 3-26.

BAIRD, G. C., HARPER, J. A., OVER, D. J., HANNIBAL, J. T. & MCKENZIE, S. C. (2023). Middle-Late Famennian stratigraphy in the “oil lands region” of northwest Pennsylvania. Devonian coastal-estuarine settings on the great Catskill Delta. – In: OVER, D. J. (ed.), Upper Devonian Strata of the Northern Appalachian Basin, Field Trip 1 – 27-29 July, 2023,

Pre-meeting Guidebook, Subcommission on Devonian Stratigraphy and IGCP 652, Reading Geologic Time in Paleozoic Sedimentary Rocks, Geneseo, New York: 28-46.

OVER, D. J., BAIRD, G. C., BRETT, C. E., KIRCHGASSER, W. T., HIGGINS, F. & TUSKES, K. (2023). Middle-Upper Devonian events and cycles in the strata along the Lake Erie shore, western New York. – In: OVER, D. J. (ed.), Upper Devonian Strata of the Northern Appalachian Basin, Field Trip 1 – 27-29 July, 2023, Pre-meeting Guidebook, Subcommission on Devonian Stratigraphy and IGCP 652, Reading Geologic Time in Paleozoic Sedimentary Rocks, Geneseo, New York: 48-83.

Contributions to: BARTHOLOMEW, A. & VER STRAETEN, C. A. (eds., 2023). Lower and Middle Devonian Strata of New York State: Genesee River Valley to the Hudson Valley, August 3-7. - International Commission on Stratigraphy, Subcommission on Devonian Stratigraphy Meeting, Geneseo, New York. Guidebook for Field trip 3:

Day 1:

BRETT, C. E., BAIRD, G. C. & VER STRAETEN, C. A. Stop 1-1 Abandoned Neid Road Quarry, east of LeRoy. - p. 4-161.

BRETT, C.E, VER STRAETEN, C.A. & BAIRD, G. C. Optional stop. Honeoye Falls Quarry. - p. 16-20.

KIRCHGASSER, W. T., OVER, D. J., BAIRD, G. C., BRETT, C. E. & ZAMBITO IV, J. J. Stop 1-2. Fall Brook. - p.17-29.

BAIRD, G. C., BRETT, C. E. & ZAMBITO IV, J. J. Stop 1-3. Taughnac Falls State Park. - p. 30-38.

Day 2:

BAIRD, G. C. & BRETT, C. E. Stop 2-1. Hubbard Shale Quarry. – p. 39-40.

BRETT, C. E. & BAIRD, G. C. Stop 2-2A-2B. Groves Creek at Oak Tree Falls and Groves Creek, upper waterfall section immediately east of Rt. 89. - p. 41-42.

BRETT, C. E. & BAIRD, G. C. Stop 2-3. Fayette Town Quarry. - p. 42-45.

BRETT, C. E. & BAIRD, G. C. Optional Stop. Stony Point, Cayuga Lake south of Aurora, NY. - p. 46.

BRETT, C. E. & BAIRD, G. C. Stop 2-4. Route 38 Roadcut, Cascade. - p. 46-52.

BRETT, C. E. & BAIRD, G. C. Stop 2-5. Long Hill Roadcut north of Moravia. - p. 53-56.

BRETT, C. E. & BAIRD, G. C. Stop 2-6. Portland point (northern RR cut). - p. 57-61

Day 3:

BRETT, C. E. & BAIRD, G. C. Stop 3-1. Tully Quality Inn shale pit. - p. 62-64.

BRETT, C. E. & BAIRD, G. C., Stop 3-3. Mottville and Delphi Station members, Pompey Hollow section. - p. 66-68.

BRETT, C. E. & BAIRD, G. C., Stop 3-4. Optional Stop. Swamp Road cut, Morrisville. - p. 69.

TM R. Thomas BECKER, CMs Z. Sarah ABOUSSALAM, Till SÖTE, Felix SAUPE, and the Münster Group

This report covers the interval from the last Newsletter to the end of August 2023. Activities of the Devonian Group at Münster included, as usual, a wide range of topics, from ammonoids and conodonts to foraminifers, trilobites, reefs, brachiopods, sedimentology, and plants, of course, in many cases in close cooperation with specialists that understand these topics better than the members of our group.



Fig. 1. Nodular limestone with septate, eroded Emsian anarcestid resembling “*Latanarcestes*” auct.; block on display in the Satun Geopark exhibition, Thailand.

A highlight in November 2022 was the participation in the International Palaeontological Congress in Thailand, and especially the field trip to the Satun Geopark in Peninsular Thailand, organized wonderfully by Clive BURRETT, Pol CHAODUMRONG, and collaborators. It included Cambrian to Carboniferous faunas, and, as a surprise, the first record of Emsian goniatites from the region and country, on display in the small Geopark museum (Fig. 1). However, the Devonian

outcrops cannot compete with the Cambrian trilobite localities on low cliffs bordering the dream beaches on Tarotao Island, which is a recommended Natural Reserve. There is still much exploration potential in the Devonian of southern Thailand.

Equally splendid was the SDS-IGCP 652 Meeting in Geneseo in late July/early August 2023 in Geneseo and the associated field trips. All was wonderfully organized by Jeff OVER and his team, with the extraordinary field guidance by Carl BRETT, Gordon BAIRD, Chuch VER STRAETEN, Jay ZAMBITO, Alex BARTHOLOMEW, Joseph HANNIBAL, Randy BLOOD, and others. It was impressive to see the enormous progress in regional Devonian stratigraphy, as exemplified by the three outstanding new New York volumes presented at the conference dinner in the PRI Museum in Ithaca (see Devonian publications). And it was even possible to collect some more goniatites and nice trilobites at well-known localities during the pre-conference and Niagara area field trips.

Ongoing research in Morocco has a focus on our third volume on the Devonian of the Moroccan Meseta, which is planned, as the first two volumes from 2020 and 2021, for the open access main journal of the Hassan II Academy of Science and Technology of Morocco (*Frontiers in Science and Engineering, Earth, Water and Ocean, Environmental Sciences*). The work is based on close cooperation with our good friend Ahmed EL HASSANI. Volume 3 will cover regions and sections of the northern and eastern parts of the Western Meseta, such as the Tiflet and Oulmes regions, the Azrou Devonian (see Geneseo abstract, ABOUSSALAM et al. 2023), the Jebel ben Arab and Bou Khedra successions, as well as the Khenifra Palaeozoic (Ziyyar and Tabainout localities). As before, there will be a special focus on the biostratigraphic dating of facies changes, palaeogeographic trends, and synsedimentary Eoviscan reworking events.

Both in the Anti-Atlas and in the Sub-Meseta Zone at the southern base of the High Atlas, our collaboration with Heiko HÜNEKE, Arwed GIBB, Paul MEHLHORN and others from Greifswald university continues. It led to the publication of a new contourite model for the condensed pelagic

successions of the Tafilalt Platform and a revised understanding of black styliolinites and *pumilio* limestones (HÜNEKE et al. 2023; GIBB et al. 2023a, full paper in submission). Another contribution on contourite sedimentation has been submitted to a *Geological Society Special Publication* volume. It is based on the Taliouine Lower Devonian in the Skoura region (GIBB et al. 2023b submitted). The stratigraphy and tectono-sedimentary evolution of the Devonian to Lower Carboniferous Tisdafine Basin at the junction of the cratonic eastern Anti-Atlas and Variscan eastern Meseta has been fully published at the end of last year (TALIH et al. 2022). There are more unpublished conodont data for two important sections of that region, Oued Ferkla (especially for the Kacak Event Interval) and Bou Tisdafine SE. Detailed cyclostratigraphic work on the first locality has been started by Anne-Christin DA SILVA and her Ph.D. student Jarno HUYGH from Liège (see their report), whom we will support. At Bou Tisdafine SE, the F-F boundary and Kellwasser beds require more detailed work (Fig. 2).



Fig. 2. Goniatite-rich Kellwasser facies at Bou Tisdafine SE, Sub-Meseta Zone, Morocco.

Because of the too many other projects, progress on ammonoid faunas from the Anti-Atlas region slowed down but is continuing (see student projects). This is also true for the trilobite and conodont faunas. For example, the first stable Gondwana *Gondwanaspis* was discovered after we had published on new Rhenish representatives of that genus (HELLING & BECKER 2022). We plan to pay attention to unpublished ammonoid-conodont-trilobite faunas at the middle-upper Givetian boundary. Apart from this, new work on Lower Carboniferous goniatites and trilobites from the

eastern Tafilalt has been published (BECKER 2023) or will be submitted soon (Peter MÜLLER & Becker in prep.). We are also very pleased that a first part of the somewhat unique goethitic plant remains from the basal upper Givetian goniatite shale of Oum el Jerane in the southern Tafilalt are finally published (MEYER-BERTHAUD et al. 2023 in press).

In the Rhenish Massif, there was a focus on the Givetian/Frasnian reef complexes, especially in the northern part. A summary of Rhenish reef extinctions was presented at the Geneseo meeting (BECKER & ABOUSSALAM 2023), which was based on more than 20 years of work and numerous previous Münster B.Sc. and M.Sc. studies. We will continue to use the service of A. MAY (Unna) to get identifications of stromatoporoids, corals, and calcareous algae. Work is in progress in new sections, e.g. in the Wuppertal region (Hahnenfurt railway station), in the Neandertal, and south of the main Hönne Valley Reef. This research received a new significance and impetus because of the potential of deeply buried Devonian reefs as resources for deep geothermal energy exploration.

Apart from the reefs, various collectors supplied us with interesting goniatites, some of which really deserve publication. For example, Harmut KAUFMANN showed us, where to collect in the Kellerwald loose blocks of typical Odershäuser Limestone with its famous but poorly known Kacak Event goniatite fauna. He managed to find new rare specimens of *Kokenia* and *Bensaidites*.

In cooperation with David DE VLEESCHOUWER, Nina WICHERN, Tomáš KUMPAN (Brno), Lawrence PERCIVAL, and others, we intensified geochemical investigations at the Frasnian-Famennian boundary, for example at Beringhauser Tunnel, Steinbruch Schmidt, and Schlupkothen. We also included samples from the Montagne Noire (Coumiac, with the help of E. SCHINDLER) and Morocco (Anajdam, Meseta, and Rich Gaouz, Tafilalt). Tomáš KUMPAN also takes part in our ongoing research on carbon isotope events at the lower/middle Frasnian transition, again at Beringhauser Tunnel.

After we had published our proposed GSSP section for the revised Devonian-Carboniferous boundary at Borkewehr (HARTENFELS et al. 2022;

HARTENFELS & BECKER 2022), we were asked to present it and classical adjacent sections (Oese, Dreher) to the International DCB Task Group in July, just before the STRATI congress in Liége. Together with Sandra I. KAISER (Stuttgart), I also submitted a review of the DCB in Morocco (see Documents section) and an elaborate discussion how to find and apply the recognized DCB steps in Rhenish sections. The latter submission will become part of a general review of their significance and regional recognition.

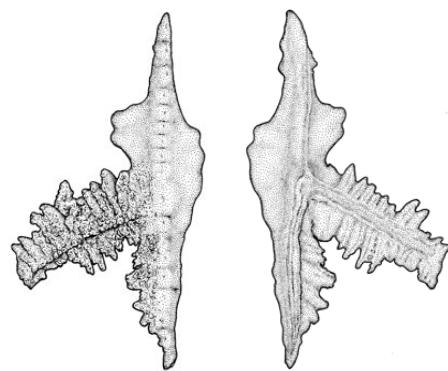


Fig. 3. Drawings (by Traudel FÄHRENKEMPER, Münster) of an intriguing new Famennian ancyrognathid from Wulankeshun, Junggar Basin, NE China.

From August 2022 to July 2023, WANG Zhihong from Wuhan joined our group as a visiting scientist. He wrote for the Chinese readership a summary of the Moroccan Devonian and we restarted our joint effort (with Sarah and Sven) to finish the second part of the Famennian conodont faunas from Wulankeshun in the Junggar Basin (Xinjiang). This will be mostly a taxonomic paper, naming and describing the various forms left in open nomenclature in the first paper published back in 2016 (WANG et al. 2016, *Palaeo* x 3, no. 448). Another unfinished cooperation project concerns lower Emsian conodont faunas from South China that are rich in *Criteriognathus* and contain some rare, unknown icriodids. Zhihong also contributed significantly to our geochemical investigations at the F-F boundary, which astonishing results will not be told until we find the time to write it up.

There are various other cooperations and projects. Ahmed ZEGHARI finished the first joint manuscript on Lower Devonian microbialitic sediments in the southern Tindouf Basin of Algeria

(see his brief report). Kathleen HISTON twisted Thomas' arms to give at the IPC in Thailand a presentation on the state of the art concerning the revised Treatise volume on the Devonian ammonoids. A summary of the talk has been submitted for a joint publication in *Earth Sciences History*. Publication of the big volume on the Central European Variscides (Ulf LINNEMANN, ed.) has been promised for the end of the year – but it seems that one paper was still missing in early September. It will include a lengthy review on the European expression of the complete sequence of Devonian and Lower Carboniferous global events (BECKER 2023 in press). In the Eifel Mountains, a joint manuscript under the lead of Jan BOHATY has been written on new Frasnian crinoids from Wallersheim Loch (Büdesheim region). The paper will include a revision of the regional lithostratigraphy and give some new goniatite records.

CM Zhor Sarah ABOUSSALAM

During the first day of the post-meeting field trip in conjunction with the Geneseo Meeting, and twenty years after finishing her Taghanic Crisis Ph.D., Sarah was eventually given the chance to see Taughannock (Taghanic) Falls in reality. Unfortunately, there was no time for cooling the legs of excursion participants in “Taghanic Water”; the banquet was waiting.

Since the last report, Sarah was very busy with the identification and SEM documentation of the many conodont faunas from the sections to be included in the 3rd Moroccan Meseta volume. She also dealt with the numerous thin-sections, which are partly complex due to the Eovariscan reworking events (Fig. 4). Results for the Azrou Devonian were presented at the Geneseo Meeting (ABOUSSALAM et al. 2023). The biostratigraphically significant conodont data for the Tisdadine Basin in the Sub-Meseta Zone of Morocco were contributed to the Ph.D. study of Amine TALIH (TALIH et al. 2022) but there are more data. They are especially significant for the conodont record across the Kacak Event and Kellwasser Crisis (Fig. 2).

Far away, there are new contacts concerning Devonian ammonoids from Colombia. This resulted in a new collaboration and a first SDS Member for that country, Andrés Felipe PASTOR-CHACÓN. Next year, he will report in our Newsletter on the research on the Colombian Devonian, with options that SDS may hold a field meeting there in the future.



Fig. 4. Thick and complex Eovariscan breccia bed (late lower Frasnian) with reworked reefal fauna at the top of our new section north of Azrou (local base of Bou Ighial Formation).

Sarah also helped with the identification of the Emsian conodonts from South China brought by Zhihong and looked after Famennian icriodids for the Wulankeshun paper. She co-supervises the M.Sc. project of Mieke LÖW and the B.Sc. project of Verena BUSCHHAUS (see below). In addition, there are the Rhenish conodont samples needed for the ongoing dating of reef extinctions (see STICHLING et al. 2022, BECKER & ABOUSSALAM 2023, second Geneseo abstract) and the samples stemming from the cooperation with the “Greifswald Contourite Group” (HÜNEKE et al. 2023; GIBB et al. 2023 submitted).

CM Felix SAUPE

completed successfully his Ph.D. on upper Frasnian conodont biodiversity in the Rhenish Massif in spring 2023. But, unfortunately, he left research and academic life completely at the end of August. His second voluminous manuscript, on the upper Frasnian to basal Famennian conodonts of Beringhauser Tunnel, based on ca. 40.000 Pa elements, and jointly with Thomas, is in its final

stage and will be soon submitted to *Palaeobiodiversity and Palaeoenvironments*. A third contribution on the top-Frasnian and F-F boundary at Schlupkothen, in the southeastern part of the Velbert Anticline, is still more incomplete.

CM Till SÖTE published with Thomas at the end of 2022 the revision and new descriptions of Büdesheim tornoceratids in *Palaeontographica*. Regrettably, he then left the university and academic research. There are two nearly finished manuscripts on the upper Frasnian tornoceratids of Oued Mzerreb (Dra Valley, SÖTE & BECKER 2022) and Ouidane Chebbi (eastern Tafilalt; SÖTE & BECKER 2022b), both southern Morocco, which require only a little bit more work. In addition, there is the unfinished manuscript on the lower Famennian ammonoids of the Canning Basin, Australia, which just awaits some time of Thomas.

Ph.D. students

Anna SAUPE completed her Ph.D. on Quaternary foraminiferes at Cologne University but returned to our Münster Group for half a year in order to finish her work on the impact of the *Annulata* and Dasberg Events on Famennian foraminifer assemblages. The manuscript on the Ziyyar successions will be part of our 3rd Moroccan Meseta volume. Unfortunately, but understandably, she left together with her husband Felix to work in future outside academia.

Stephan EICHHOLT is only slowly making progress with his paper on the reef microfacies and development of the Oulmes region but it will be done eventually.

Sören STICHLING works full-time with the Geologischer Dienst NRW – Landesbetrieb - in Krefeld but still hopes to finalize his/our project on the Höhne Valley Reef in the northern Rhenish Massif by studying cores of the lagoonal Asbeck Member. He is mostly involved with geological mapping in the Rhenish Massif, currently in western parts (Velbert Anticline), moving gradually eastwards.

M.Sc. Students

Alexander KLEMENT is gradually finishing his project on the morphometry, taxonomy, and palaeobiogeographic relationships of middle Famennian ammonoids from the Canning Basin.

Mieke LÖW continued her project on the revision of upper Frasnian manticoceratids from the Rhenish Massif, based on type material, topotypes, and morphometry. It turned out to be more difficult than anticipated, as type designations are lacking, have been unclear or contradictory. Presentations of the project outline and problems were given at the IPC in Khon Kaen in Thailand (November 2022, Löw & BECKER 2022b).

Jannes NAUERT started a M.Sc. project on the ontogenetic morphometry, taxonomy and regional biodiversity of upper Famennian clymeniids (Cymaclymeniidae, Cyrtoclymeniidae, and Kosmoclymeniidae) in the basinal facies of the Maider Basin of southern Morocco.

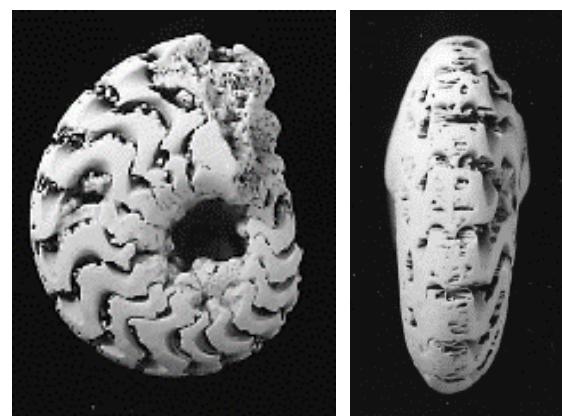


Fig. 5. New species of *Koenenites* from the lower Frasnian Sadler Formation of the Canning Basin, Western Australia.

B.Sc. students

Verena BUSCHHAUS started a project on an unusually rich actinopterygian scale and teeth occurrence in the initial, biostromal part of the Upper Hofermühle Reef ('Velbert Anticline, Rhenish Massif). The assemblage is early upper Givetian in age.

Maximilian GROßKLAUS began a thesis on the morphometrics and taxonomy of lower Frasnian goniatite of the Canning Basin (Fig. 5), collected 30

years ago by Michael HOUSE, Bill KIRCHGASSER, and Thomas.

Viola KÖNIG CASTRO decided to do a B.Sc. project on phacopid trilobites from around the Taghanic Crisis of the Tafilalt, Morocco.

Publications

Peer-reviewed papers 2022-2023

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LÖW, M., SÖTE, T., BECKER, R. T., STICHLING, S., MAY, A., ABOUSSALAM, Z. S. & ZOPPE, S. F. (2022). The initial phase of the Höhne Valley Reef at Binolen (northern Rhenish Massif, Middle Devonian). – Palaeobiodiversity and Palaeoenvironments, **102**: 573-612; doi.org/10.1007/s12549-022-00540-4.

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- Morocco. - Bulletin de l'Institute Scientifique, Rabat, **44**: 27-53.
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- Abstracts (autumn 2022 to summer 2023)*
- ABOUESSALAM, Z. S., BECKER, R. T., HARTENFELS, S. & EL HASSANI, A. (2023). Devonian conodont stratigraphy and facies development of the Azrou region (eastern part of western Moroccan Meseta). - In: OVER, D. J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks, Geneseo, New York, 27 July – 06 August 2023, Program and Abstracts: 14-15.
- BECKER, R. T. (2022). The Treatise volume on Devonian ammonoids – a tale of unreadable disks, photo boxes, and outdated taxonomic concepts. – In: 6th International Palaeontological Congress, 7th to 11th November 2022, Khon Kaen, Abstracts, Session 3: 1 p.
- BECKER, R. T. & ABOUESSALAM, Z. S. (2023). Impact of global events on the drowning and extinction of Givetian/Frasnian reefs in the northern Rhenish Massif (Germany). – In: OVER, D. J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks, Geneseo, New York, 27 July – 06 August 2023, Program and Abstracts: 19-20.
- BECKER, R. T., SAUPE, F. & ABOUESSALAM, Z. S. (2022). The enigmatic end-Frasnian pelagic mass extinction (top Kellwasser Crisis) – new evidence for correlation with a peak of seismically induced sedimentary events. - In: 6th International Palaeontological Congress, 7th to 11th November 2022, Khon Kaen, Abstracts, Session 9: 1 p.
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- HARTENFELS, S. & BECKER, R. T. (2022). The evolution of early *Protognathodus* and their significance for the redefinition of the Devonian/Carboniferous boundary. – In: SCHWEIGERT, G. (ed.), 93. Jahrestagung der Paläontologischen Gesellschaft, Sep. 19th to 23rd at the Staatliches Museum für Naturkunde Stuttgart, Abstract Volume: 18.
- GIBB, A., HÜNEKE, H., MEHLHORN, P., GIBB, L., ABOUESSALAM, Z. S., BECKER, R. T., EL HASSANI, A. & BAIDDER, L. (2023). Frasnian contourite channel-drift system: Dense shelf-water cascading of anoxic water from the northern Gondwana Epeiric Sea (Tafilelt, Morocco). – In: The 4th Deep Water Circulation Research Conference, 24-26 May 2023, Edinburgh, Abstracts: 1 p.
- LÖW, M. & BECKER, R. T. (2022). Revision of upper Frasnian Rhenohercynian manticoceratids (Gephuroceratidae, Ammonoidea). - In: 6th International Palaeontological Congress, 7th to 11th November 2022, Khon Kaen, Abstracts, Session 3: 1 p.
- SÖTE, T. & BECKER, R. T. (2022a). The Frasnian ammonoid succession of Ouidane Chebbi (eastern Tafilelt, Morocco). - In: SCHWEIGERT, G. (ed.), 93. Jahrestagung der Paläontologischen Gesellschaft, Sep. 19th to 23rd at the Staatliches Museum für Naturkunde Stuttgart, Abstract Volume: 61.
- SÖTE, T. & BECKER, R. T. (2022b). The Frasnian ammonoid succession of Oued Mzerreb (Dra Valley, Morocco). - In: 6th International Palaeontological Congress, 7th to 11th November 2022, Khon Kaen, Abstracts, Session 9: 1 p.
- WICHERN, N. M. A., BIALIK, O. M., PERCIVAL, L. M. E., KASKES, P., NOHL, T., BECKER, R. T. & DE VLEESCHOUWER, D. (2023). Deciphering the role of terrestrial/atmospheric interactions in Late Devonian Kellwasser black shale deposition: A High-Resolution Cyclostratigraphy study of the Winsenberg section (Rhenish Massif, Germany). –

In: EGU General Assembly 2023, Vienna, Austria & Online, 23-28 April 2023, Abstracts, 1 p.

WICHERN, N., BIALIK, O. M., NOHL, T., PERCIVAL, L.M.E., KASKES, P., BECKER, R. T. & DEVLEESCHOUWER, D. (2023). Deciphering the role of terrestrial/atmospheric interactions in Late Devonian Kellwasser black shale deposition: A high-resolution cyclostratigraphic study of the Winsenberg section (Rhenish Massif, Germany). - In: OVER, D. J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks, Geneseo, New York, 27 July – 06 August 2023, Program and Abstracts: 80-81.

Devonian thesis

SAUPE, F. (2023). Conodont biostratigraphy and palaeodiversity in the upper Frasnian of the Rhenish Massif. – Ph.D. Thesis, Münster University, 247 pp.

SÖTE, T. (2022). Systematics and evolution of the Tornoceratina (Ammonoidea) at the Kellwasser Crisis (Frasnian, Upper Devonian). – Ph.D. Thesis, Münster University, 292 pp.

TM Carlton E. BRETT

A Year of Devonian: In 2022 and 2023 a great deal of effort was extended toward preparation for the two-week SDS Field Conference organized by TM Jeff OVER and his team and based at SUNY Geneseo for talks and with field trips starting in Cleveland and ending in the southern Hudson Valley near Kingston, NY, on July 26 to August 6, 2023. Continued work and extensive final revisions considering new discoveries from drill core, led to publication of three updated chapters on Middle Devonian stratigraphy for a *Bulletins of American Paleontology* monograph on *The Devonian of New York* edited by CM Charles VER STRAETEN, TM Jeff OVER, J. WOODROW. CMs Gordon BAIRD, Alex BARTHOLOMEW, and Jay ZAMBITO co-authored extensive manuscripts on stratigraphic terminology, the re-description of units, chronostratigraphy, and facies analysis of the Givetian of New York and adjacent regions (BRETT et al. 2023; BAIRD et al. 2023). VER STRAETEN et al. (2023) discuss the Eifelian Onondaga Formation and Marcellus subgroup of New York. The full three-volume set on the Devonian of New York has been published as of July 2023 in time for the SDS

Devonian meeting in New York State at which hard copies of the work were available.

In addition, we collectively prepared three guidebooks for the pre-, mid-, and post-meeting field trips. I was particularly involved in preparing the mid-meeting guide, which summarizes late Ordovician to Middle Devonian stratigraphy as well as Quaternary history of the Niagara Frontier region (BRETT 2023). It is our intent to publish these guides as pdfs available on-line through the Paleontological Research Institution (PRI). We enjoyed leading marathon field trips across New York State during this meeting and benefitted from extensive discussions of ideas with many colleagues from around the globe. I especially thank Jeff OVER for his excellent organization and running of the meeting and both Jeff and Chuck VER STRAETEN, together with PRI volume editors Jon HENDRICKS and Elizabeth HERMSEN, for their exceptional efforts in editing the three volume Devonian of New York and bringing it to timely publication, and to Warren ALLMON, Director, for facilitating and promoting all the activities in a “Year of Devonian” through PRI.

I continued work on a major new initiative launched in 2022, with CM Jay ZAMBITO and Thomas ALGEO (University of Cincinnati), on the thick (>600 m) core drilled by Cargill Salt Company at Portland Point, Lansing Township, on Cayuga Lake in central New York. It is our objective to establish a standard reference section for litho-, chemo-, and sequence stratigraphy for the northern Appalachian Basin. To date, we have logged the entire core for lithology, sedimentary features, and all identifiable fossils, boundaries and thicknesses of all formations, member and submembers, and most key beds have been established (including Silurian units) and the core has been photographed. In summer of 2023 some 457 m (1500') has been scanned for high-resolution spectral gamma ray profiles. We are working with TM Anne-Christine DA SILVA and her Ph.D. student Jarno HUYGH on time-series analysis of magnetic susceptibility and high-resolution gamma ray logging, as well as elemental profiles to examine the cyclostratigraphy of the Eifelian-Givetian interval. This can be calibrated with the known conodont and other

biostratigraphic and sequence stratigraphic record projected from outcrop into the core. We hope to refine the estimates of stage and biozone duration based on astrochronology.

In addition, magnetic susceptibility has been recorded at regular intervals through the entire core and powders have been drilled through all calcareous units (most of the core) at 0.6 to 0.1.5 m intervals for analysis of $\delta^{13}\text{C}_{\text{carb}}$, C/S, and XRF for major and trace elements. Thomas ALGEO also intends to analyze B/Ga ratios of the samples as a proxy for paleosalinity.

During 2022 to 2023 Gordon BAIRD and I continued work with Greg DIETL (Curator), Leslie SKIBINSKI (Collection Manager) and Stephen MAYER (assistant and expert on local Devonian fossils) at PRI. Funding from a National Science Foundation (NSF) Grant enabled us to assemble, integrate, and digitize our combined collections from the Devonian of New York State and elsewhere. This effort is combined with plans for a digital atlas of Middle Devonian fossils and an extensive database of geographic and stratigraphic data, based on these collections. During the SDS banquet at the Museum of the Earth, August 3, 2023 a wing of PRI, devoted to housing stratigraphic collections of Devonian fossils, was dedicated to Gordon BAIRD and myself and our wives. We were deeply honored by this gesture.

Publications

For the various contributions to the new monograph on the New York Devonian see the Devonian publications section.

Field guidebooks of the Geneseo Meeting

OVER, D. J., BAIRD, G. C., BRETT, C. E., KIRCHGASSER, W. T., HIGGINS, F. & TUSKES, K. (2023). Middle-Upper Devonian events and cycles in the strata along the Lake Erie shore, western New York. – In: OVER, D. J. (ed.), Upper Devonian Strata of the Northern Appalachian Basin, Field Trip 1 – 27-29 July, 2023, Pre-meeting Guidebook, Subcommission on Devonian Stratigraphy and IGCP 652, Reading Geologic Time in Paleozoic Sedimentary Rocks, Geneseo, New York: 48-83.

BRETT, C. E. (2023). The4 Upper Ordovician-Devonian and Pleistocene geological history of Western New

York: A guide to the geology of the Niagara Frontier. – International Subcommission on Devonian Stratigraphy, Geneseo, New York, Field Trip 2 – Monday – July 31, 2023, 131 pp. [with BRETT, C.E. & BRETT, B.-L. as eds.].

Contributions to: BARTHOLOMEW, A. & VER STRAETEN, C. A. (eds., 2023). Lower and Middle Devonian Strata of New York State: Genesee River Valley to the Hudson Valley, August 3-7. - International Commission on Stratigraphy, Subcommission on Devonian Stratigraphy Meeting, Geneseo, New York. Guidebook for Field trip 3 [for details of locality descriptions see list in report by Gordon BAIRD].

TM Carlo CORRADINI

My research is mainly devoted to conodont biostratigraphy from Silurian to Lower Carboniferous in several regions, specially focusing on the Lower Devonian, and Silurian/Devonian and Devonian/Carboniferous boundaries. The latter are mainly related with the International Task Group on the redefinition of the Devonian/Carboniferous Boundary (led by CM M. ARETZ, Toulouse). The Carnic Alps represents my main research area. Geology and stratigraphy of several sectors are investigated (together with several colleagues). Main researched in progress focus on the Lochkovian stratigraphy, the Lochkovian/Pragian boundary, and the evolution of the sedimentary basin during the Lower and Middle Devonian; the older pelagic limestones above the main reefal bodies are under study, too.

Joint-researches with colleagues from various institutions continue: in the Montagne Noire (France), research deals with conodonts, stratigraphy and facies in the Famennian and lowermost Tournaisian (with CMs C. GIRARD, R. FEIST, and others); studies on conodonts from some sections in the Ardennes are in progress (with J. DENAYER). Taxonomic studies on Lower (with CM Maria G. CORRIGA) and Late Devonian (with CM C. GIRARD and others) conodonts are in progress.

Publications

Papers related to the Devonian

CORRADINI, C., CORRIGA, M. G., DORIGO, L., KIDO, E., PONDRELLI, M., SIMONETTO, L., SPALLETTA, C.,

- SUTTNER, T. J. & ZUCCHINI, R. (2022). Pramosio e Avostanis. - Le guide del Geoparco della Alpi Carniche, **4**: 48 pp.; Comunità di montagna della Carnia editore; ISBN: 978 88 96546 10 9.
- CORRADINI, C. & SIMONETTO, L. (2023). The stratigraphy of the Pre-Variscan Sequence of the Carnic Alps in the papers by Michele Gortani and Vinassa de Regny. - In: CORRADINI, C. & MUSCIO, G. (eds.), Geology and Palaeontology of Friuli and adjacent areas: 13-16; Udine, Museo Friulano di Storia Naturale; ISBN: 978 88 88192 73 4.
- CORRADINI, C., PONDRELLI, M., CORRIGA, M. G. (2023a). The Geotrail “Luca Simonetto” at Cason di Lanza Pass (Carnic Alps, Italy). - In: CORRADINI C. & MUSCIO G. (eds.), Geology and Palaeontology af Friuli and adjacent areas: 69-75; Udine, Museo Friulano di Storia Naturale; ISBN 978 88 88192 73 4.
- CORRIGA, M. G., FLORIS, M. & CORRADINI, C. (2022). The Silurian/Devonian sequence at Perda s'Altari (SW Sardinia, Italy). - Bollettino della Società Paleontologica Italiana, **61**: 71-86; doi: 10.4435/BSPI.2022.02.
- CORRIGA, M. G., CORRADINI, C., PONDRELLI, M. & SIMONETTO, L. (2023). The Lochkovian (Lower Devonian) of the Carnic Alps. - In: CORRADINI, C. & MUSCIO, G. (eds.), Geology and Palaeontology af Friuli and adjacent areas: 17-20; Udine, Museo Friulano di Storia Naturale; ISBN: 978 88 88192 73 4.
- FERRETTI, A., CORRIGA, M. G., SLAVIK, L. & CORRADINI, C. (2022a). Running across the Silurian/Devonian boundary along northern Gondwana: A conodont perspective. - Geosciences, **12** (43): 25 pp.; doi:10.3390/geosciences12010043.
- FERRETTI, A., CORRADINI, C., FAKIR, S., MALFERRARI, D. & MEDICI, L. (2023). To be or not to be a conodont. The controversial story of *Pseudooneotodus* and *Eurytholia*. - Marine Micropaleontology, **182** (102258); doi: 10.1016/j.marmicro.2023.102258.
- GIRARD, C., CHARRUALT, A.-L., GLUCK, Y., CORRADINI, C. & RENAUD, S. (2022a). Deciphering the morphological variation and its ontogenetic dynamics in the Late Devonian conodont *Icriodus alternatus*. - Fossil Record, **25**: 25-41; doi:10.3897/fr.25.80211.
- GIRARD, C., CHARRUALT, A.-L., GLUCK, Y., CORRADINI, C. & RENAUD, S. (2022b). 3D models related to the publication: Deciphering the morphological variation and its ontogenetic dynamics in the Late Devonian conodont *Icriodus alternatus*. - MorphoMuseuM, **8** (e161): 3 pp.; doi:10.18563/journal.m3.161.
- PERCIVAL, L., MARYNOWSKI, L., BAUDIN, F., GODERIS, S., DE VLEESCHOUWER, D., RAKOCIŃSKI, M., NARKIEWICZ, K., CORRADINI, C., DA SILVA, A.-C. & CLAEYS, P. (2022). Combined nitrogen isotope and cyclostratigraphy evidence for regional variability in Frasnian–Famennian environmental change. - Geochemistry, Geophysics, Geosystems, **23** (e2021GC010308): 18pp.; doi: 10.1029/2021GC010308.
- PONDRELLI, M., SIMONETTO, L., CORRADINI, C., CORRIGA, M. G., PERRI, M. C. & SPALLETTA, C. (2023). The Pragian to Frasnian basin evolution in the Carnic Alps (Austria-Italy). - In: CORRADINI, C. & MUSCIO, G. (eds.), Geology and Palaeontology af Friuli and adjacent areas: 35-38; Udine, Museo Friulano di Storia Naturale; ISBN 978 88 88192 73 4.
- SPALLETTA, C., CORRADINI, C., SIMONETTO, L., CORRIGA, M. G., PERRI, M. C. & PONDRELLI, M. (2023). The Devonian sequence at the Freikofel Mt (Carnic Alps, Austria-Italy). - In: CORRADINI, C. & MUSCIO, G. (eds), Geology and Palaeontology af Friuli and adjacent areas: 53-56; Udine, Museo Friulano di Storia Naturale; ISBN 978 88 88192 73 4.
- Abstracts*
- ARETZ, M. & CORRADINI, C. (2023). Moving forward with the redefinition of the Devonian/Carboniferous Boundary. - STRATI 2023, Book of Abstracts: 244-245.
- CORRADINI, C. & ARETZ, M. (2022). The redefinition of the Devonian/Carboniferous Boundary: state of the art. - In: CHEN, Y., JIANG, H. & LAI, X. (eds.), 2022 Pander Society Fifth International Conodont Symposium (ICOS5), Program and Abstracts: 69-70.
- CORRADINI, C., CORRIGA, M.G., PONDRELLI, M. & SUTTNER, T. J. (2023b). The Lochkovian-Pragian Boundary (Lower Devonian) in the Carnic Alps, Italy and Austria. - STRATI 2023, Book of Abstracts: 270-271.
- FERRETTI, A., CORRADINI, C., FAKIR, S., MALFERRARI, D. & MEDICI, L. (2022b). To be or not to be a conodont. The controversial story of *Pseudooneotodus* and *Eurytholia*. - In: CHEN, Y., JIANG, H. & LAI, X. (eds.), 2022 Pander Society Fifth International Conodont Symposium (ICOS 5), Program and Abstracts: 16.

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 am studying several classic and new sections of Silurian and Early Devonian age, mainly in the central sector of the chain. Main research in progress focuses on Lochkovian conodonts and the Lochkovian/Pragian boundary.

In Sardinia, a paper on the Silurian-Lower Devonian area of Perda S'altari has been published (CORRIGA et al. 2022), and I am revising the conodont fauna of the classical Mason Porcus section. My research also deals with Silurian and Devonian conodont taxonomy, mainly focusing on Lower Devonian ozarkodinids (with Carlo CORRADINI).

Publications

Papers

CORRADINI, C., CORRIGA, M. G., DORIGO, L., KIDO, E., PONDRELLI, M., SIMONETTO, L., SPALLETTA, C., SUTTNER, T. J. & ZUCCHINI, R. (2022). Pramosio e Avostanis. - Le guide del Geoparco della Alpi Carniche, **4**: 48 pp.; Comunità di montagna della Carnia editore; ISBN 978 88 96546 10 9.

CORRADINI, C., PONDRELLI, M., CORRIGA, M. G. (2023). The Geotrail "Luca Simonetto" at Cason di Lanza Pass (Carnic Alps, Italy). - In: CORRADINI C. & MUSCIO G. (eds.), Geology and Palaeontology af Friuli and adjacent areas: 69-75; Udine, Museo Friulano di Storia Naturale; ISBN 978 88 88192 73 4.

CORRIGA, M. G., FLORIS, M. & CORRADINI, C. (2022). The Silurian/Devonian sequence at Perda s'Altari (SW Sardinia, Italy). - Bollettino della Società Paleontologica Italiana, **61**: 71-86; doi: 10.4435/BSPI.2022.02.

CORRIGA, M. G., CORRADINI, C., PONDRELLI, M. & SIMONETTO, L. (2023). The Lochkovian (Lower Devonian) of the Carnic Alps. - In: CORRADINI, C. & MUSCIO, G. (eds.), Geology and Palaeontology af Friuli and adjacent areas: 17-20; Udine, Museo Friulano di Storia Naturale; ISBN: 978 88 88192 73 4.

FERRETTI, A., CORRIGA, M. G., SLAVIK, L. & CORRADINI, C. (2022). Running across the Silurian/Devonian boundary along northern Gondwana: A conodont

perspective. - Geosciences, **12** (43): 25 pp.; doi:10.3390/geosciences12010043.

PONDRELLI, M., SIMONETTO, L., CORRADINI, C., CORRIGA, M. G., PERRI, M. C. & SPALLETTA, C. (2023). The Pragian to Frasnian basin evolution in the Carnic Alps (Austria-Italy). - In: CORRADINI, C. & MUSCIO, G. (eds.), Geology and Palaeontology af Friuli and adjacent areas: 35-38; Udine, Museo Friulano di Storia Naturale; ISBN 978 88 88192 73 4.

SPALLETTA, C., CORRADINI, C., SIMONETTO, L., CORRIGA, M. G., PERRI, M. C. & PONDRELLI, M. (2023). The Devonian sequence at the Freikofel Mt (Carnic Alps, Austria-Italy). - In: CORRADINI, C. & MUSCIO, G. (eds), Geology and Palaeontology af Friuli and adjacent areas: 53-56; Udine, Museo Friulano di Storia Naturale; ISBN 978 88 88192 73 4.

Abstract

CORRADINI, C., CORRIGA, M.G., PONDRELLI, M. & SUTTNER, T. J. (2023). The Lochkovian-Pragian Boundary (Lower Devonian) in the Carnic Alps, Italy and Austria. - STRATI 2023, Book of Abstracts: 270-271.

TM Catherine CRÔNIER

My current projects are mainly devoted to Devonian trilobites as potential windows into how morphological disparity and diversity changes over deep time, particularly across major mass extinction boundaries.

I am part of a collaborative effort to characterize faunas from southern Mongolia (collections of P. KÖNIGSHOF, A. MUNKHJARGAL, J. A. WATERS, and S.K. CARMICHAEL). Southern Mongolia is centrally located within the Central Asian Orogenic Belt (CAOB), which is the world's largest Palaeozoic accretionary orogenic belt. Unfortunately, only sporadic reports provided information on different fossil groups and the stratigraphy of this area. Our Working Group conducted fieldwork in Mongolia in summer 2022 with the goal of obtaining detailed sedimentological descriptions and revised biostratigraphical and palaeontological data from this relatively unexplored area.

I am still part of a collaborative effort to characterize the patterns of diversity and disparity in trilobites with Argentinian (D. BALSEIRO, A.

BIGNON, J. J. RUSTAN, F. SERRA, and B. WAISFELD) and French (V. BAULT, C. MONNET) colleagues. Exhaustive datasets were compiled in order to reveal their long-term evolutionary history leading to their extinction. Results on the trilobite diversity patterns were published in *Palaeogeography*, *Palaeoclimatology*, *Palaeoecology* (2021) and *Earth-Science Reviews* (2022). The morphological history of the successful phacopid family is now published in *Palaeontology*;

Finally, as vice-chair, we organized the fourth International Congress on Stratigraphy, STRATI 2023, in Lille, France, 11th-13th July 2023. This congress was a success with 285 participants and six distinguished guest speakers (L. ALEGRET, L. ANGIOLINI, M. M. JOACHIMSKI, S. HOLLAND, J. LASKAR, and C. SCOTSESE). One session has been devoted to the Devonian. One post-conference (three days) has been devoted to the Devonian and Carboniferous of southern Belgium (guided by J. DENAYER and B. MOTTEQUIN).

Publications

ABBACHE, A., OUALI MEHADJI, A., ALLAIRE, N., MONNET, C., CRÔNIER, C., ZAAGANE, M. & FETATI, A. (2022). Upper Devonian «griottes» facies of the Ben-Zireg area (Bechar Basin, southwestern Algeria): Stratigraphy, microfacies analysis and paleo-environmental reconstruction. - *Journal of African Earth Sciences*, **196** (104730): 11 pp.; DOI: 10.1016/j.jafrearsci.2022.104730.

ALLAIRE, N., GINOT, S., DE BAETS, K., KORN, D., GOUDMAND, N., MONNET, C. & CRÔNIER, C. (2023). Morphological disparity of early ammonoids: a geometric morphometric approach to investigate conch geometry. - *Acta Palaeontologia Polonica*, **68**: 193–212; DOI:10.4202/app.01033.2022.

BAULT, V., CRÔNIER, C. & BIGNON, A. (2022a). The influence of palaeogeography and tectonic events on trilobite distributions in Morocco and northwestern Algeria. - *Geological Magazine*, **159**: 707–729; DOI: 10.1017/S001675682100131X.

BAULT, V., CRÔNIER, C. & MONNET, C. (2022a). Morphological disparity trends in Devonian trilobites from North Africa. – *Palaeontology*, e12623; DOI: 10.1111/pala.12623.

BAULT, V., BALSEIRO, D., MONNET, C. & CRÔNIER, C. (2022c). Post-Ordovician trilobite diversity and evolutionary faunas. - *Earth-Science Reviews*, **230**; DOI: 10.1016/j.earscirev.2022.104035.

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BAULT, V., CRÔNIER, C., MONNET, C., BALSEIRO, D., SERRA, F., WAISFELD, B., BIGNON, A. & RUSTAN, J. J. (2023b). Rise and fall of the phacopids: the morphological history of a successful trilobite family. – *Palaeontology*, e12673; DOI: 10.1111/pala.12673.

CRÔNIER, C. & WATERS, J. (2023). Late Devonian (Famennian) phacopid trilobites from western Xinjiang, Northwest China. - *Palaeobiodiversity and Palaeoenvironments*, **103**: 327–340; DOI: 10.1007/s12549-022-00547-x.

SEROBYAN, V., DANIELIAN, T., CRÔNIER, C., GRIGORYAN, A. & MOTTEQUIN, B. (2022a). *Aramazdospirifer orbelianus* (ABICH, 1858) n. comb., a new cyrtospiriferid brachiopod genus and a biostratigraphically important species from the lower Famennian (Upper Devonian) of Armenia. - *Comptes Rendus Palevol*, **21**: 145–156; DOI: 10.5852/cr-palevol2022v21a6.

SEROBYAN, V., DANIELIAN, T., CRÔNIER, C., GRIGORYAN, A., & MOTTEQUIN, B. (2022b). New and revised cyrtospiriferid (Spiriferida) brachiopods from the lower Famennian (Upper Devonian) of Armenia. - *Journal of Paleontology*, **96**: 839–858; DOI: 10.1017/jpa.2022.9.

TM Anne-Christine DA SILVA

We have been sampling with J. DENAYER the Devonian Carboniferous boundary records of Chaxhe and Anseremme in Belgium. We measured at high resolution magnetic susceptibility, portable XRF, and carbon and oxygen isotopes. The project funded by the National Belgian Science foundation (FNRS) started in June 2022 in collaboration with Michel CRUCIFIX (PI) from Louvain-la-Neuve University and is called “*WarmAnoxia*”. The aim is to evaluate how astronomical climate forcing can have an impact on anoxia development during the Devonian with three

parallel Ph.D. projects. **Justin GÉRARD** will focus on testing the physical and biogeochemical consistency of different hypotheses through modelling, with a focus on the deep ocean; while **L. SABLON** focusses on the atmosphere and shallow ocean (Louvain-La-Neuve). The Ph.D. candidate **Jarno HUYGH** (Liege university) will be working on reassessing existing data and producing new data to highlight the link between astronomical forcing and key Devonian anoxic events, with a focus on the Eifelian and Givetian. Jarno HUYGH has been working with Carlton BRETT, I. FORSYTHE and T. ALGEO (University of Cincinnati) on the Lansing core record (Givetian), producing the Gamma Ray Spectrometry record. We also did an exploration field work in Morocco and decided to sample at high resolution the Oued Ferkla (Eifelian-Givetian) in the Tisdafine Basin, which has been visited by SDS in 2013 and which was more recently studied by TALIH et al. (2022).

Our funding in the framework of the IGCP-652 project “Reading time in Paleozoic sedimentary rocks” is now finished with a fantastic ending at the Geneseo Meeting (New York State) in conjunction with the SDS meeting.

C. ZEEDEN developed a new technique to extract the frequency of precession and obliquity from multiple records, allowing to calculate the Earth-Moon distance and length of the day through the Devonian.

Publications

ZEEDEN, C., LASKAR, J., DE VLEESCHOUWER, D., PAS, D. & DA SILVA, A. C. (2023 in print): Earth's rotation and Earth-moon distance in the Devonian derived from multiple geological records. - *Earth and Planetary Science Letters*, **621** (118348).

Abstracts

CRUCIFIX, M., SABLON, L. GERARD, J., GODDERIS, Y. & DA SILVA, A.-C. (2023). Numerical simulations of the effects of astronomical forcing on nutrient supply and oxygen levels during the Devonian. – In: OVER, D. J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks, Geneseo, New York, 27 July – 06 August 2023, Program and Abstracts: 27.

DA SILVA, A.-C., ARTS, M., CRUCIFIX, M., FRANCK, L., HUYGH, J., OMAR, H. & DENAYER, J. (2023a). The Hangenberg Crisis (Devonian-Carboniferous boundary) timing and climatic forcing (Chaxhe and Anseremme sections, Belgium). – In: OVER, D. J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks, Geneseo, New York, 27 July – 06 August 2023, Program and Abstracts: 30.

DA SILVA, A.-C., BRETT, C. E., BARTHOLOMEW, A., VER STRRAETEN, C., HILGEN, F. & DEKKERS, M. J. (2023b). The Kingston record, New York State, U.S.A. – a window to the Devonian paleoclimate and to the duration of the Emsian. – In: OVER, D. J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks, Geneseo, New York, 27 July – 06 August 2023, Program and Abstracts: 31.

HUYGH, J., GÉRARD, J., SABLON, S., CRUCIFIX, M. & DA SILVA, A.-C. (2023). Investigating the link between Devonian anoxic events and astronomical forcing. – In: OVER, D. J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks, Geneseo, New York, 27 July – 06 August 2023, Program and Abstracts: 48.

CM David DE VLEESCHOUWER

The DFG-funded research project titled "*Astronomical Signatures in Late Devonian Black Shales of the Rhenish Massif*" conducted by the Earth System Science working group in Münster is currently operating at full speed. Within this project, our Ph.D. student, **Nina WICHERN**, is delving into the Kellwasser, *Annulata*, Dasberg, and Hangenberg intervals. Her primary objective is to assess whether there is a discernible connection between the precise timing of these oceanic anoxic events and specific astronomical configurations. In the autumn of 2021, we successfully procured samples from the Winsenberg roadcut, specifically focusing on the Kellwasser Crisis interval. As a result, we have produced a manuscript that provides a comprehensive cyclostratigraphic and paleoclimatologic interpretation. Currently, this manuscript is undergoing the peer review with Climate of the Past. This manuscript is already accessible as a pre-print (WICHERN et al. 2023), and

the findings were disseminated at the Geneseo SDS meeting.

In the summer of 2022, we carried out a detailed sampling at the Effenberg quarry, covering the *Annulata* to Dasberg interval with centimeter-scale resolution. This initiative led to the collection of over 500 samples, subsequently analyzed for

elemental geochemistry via X-Ray Fluorescence (XRF) throughout 2022 and 2023. Furthermore, during the summer of 2023, we undertook the sampling of the Oberrödinghausen railroad cut, encompassing the Dasberg to Hangenberg interval, also to be analyzed through XRF techniques.

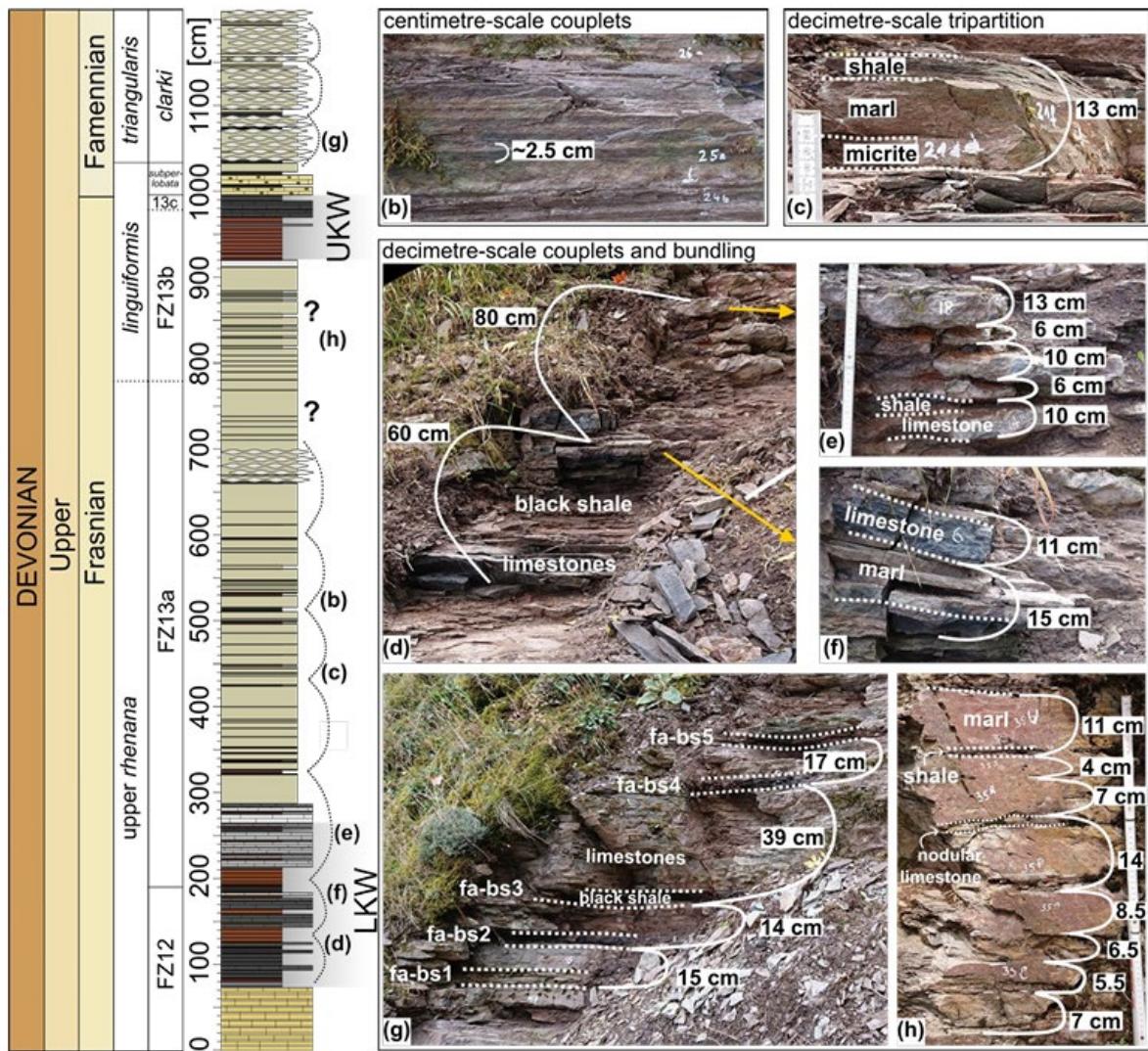


Fig. 1. Rhythmic lithologies observed in the Winsenberg section. Decimetre-scale couplets and tripartition are ascribed to precession forcing. From WICHERN et al. (2023).

In conjunction with Nina WICHERN's endeavors, M.Sc. student **Jana KLISIEWICZ** dedicated her research to the Wallnut Creek section in New York State, specifically focusing on the Kellwasser interval. Jana constructed a cyclostratigraphy for this section, which aligns with independent astrochronologic interpretations by Faye HIGGINS (SUNY-Geneseo) for the same section. We are currently in the process of preparing a manuscript based on these results for submission to GSA Bulletin. Additionally, in collaboration with Randy BLOOD, we conducted a ~10 m drill core excavation from the top of the Pipe Creek down to the underlying Angola Formation at the Wallnut Creek locality. This newly acquired drill core will provide us with invaluable insights into the Lower Kellwasser event and its antecedent conditions at millennial (and maybe even centennial) resolution, thanks to micro-XRF analyses.

Publication

WICHERN, N. M. A., BIALIK, O M., NOHL, T., PERCIVAL, L. M. E., BECKER, R. T., KASKES, P., CLAEYS, P. & DE VLEESCHOUWER, D. (2023). Astronomically-paced climate and carbon-cycle feedbacks in the lead-up to the Late Devonian Kellwasser Crisis. - Climate of the Past Discussions [preprint]; <https://doi.org/10.5194/cp-2023-58>.

CM James EBERT

[For publication see the contribution to the New York Devonian monograph in the Devonian publications section.]

CM Ahmed EL HASSANI

is working with Thomas BECKER and Sarah ABOUSSALAM on the third volume of the Devonian and Lower Carboniferous of the Moroccan Meseta. For a new book on the extraordinary geological heritage of Morocco – this time in English – see also the Devonian publications section. For further references see the report by Heiko HÜNEKE.

Publications

EL HASSANI, A. (2023). A Geologist's Paradise. Tracing Morocco's Geological History from Early Explorers to the Modern Era. – 382 pp.; Rabat, Hassan II Academy Press.

ABOUSSALAM, Z. S., BECKER, R. T., HARTENFELS, S. & EL HASSANI, A. (2023). Devonian conodont stratigraphy and facies development of the Azrou region (eastern part of western Moroccan Meseta). - In: OVER, D. J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks, Geneseo, New York, 27 July – 06 August 2023, Program and Abstracts: 14-15.

CM Robert W. GESS

With the support of the Millennium Trust and GENUS (the DSI-NRF Centre of Excellence in Palaeosciences), the Devonian Ecosystems Project, based at the Albany Museum in Makhanda, Eastern Cape, South Africa, has continued to study evidence regarding high palaeolatitude Devonian Ecosystems.

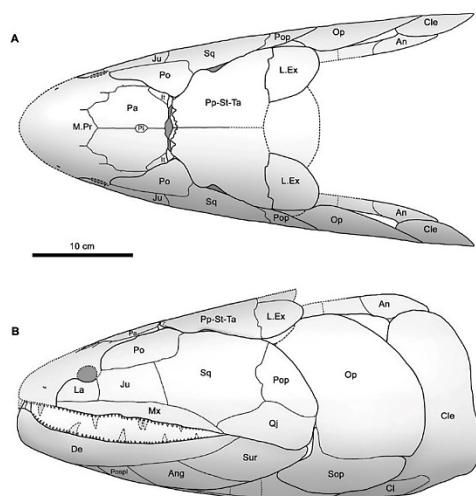


Fig. 1. Reconstruction of the head and shoulder girdle of *Hyneria udlezinye*.

A further contribution to description of the Famennian Waterloo Farm lagerstätte has been the description (by Rob GESS & Per E. AHLBERG) of the top non-marine predator within the assemblage. This is a tristichopterid, *Hyneria udlezinye*, which was at least 2.7 metres long. *Hyneria* belongs to a group of giant

tristichoperid fish that emerged in the Late Devonian, probably in Gondwana. Indeed, all other members of this clade were formerly known from Gondwana, with some also known from Laurasia. Prior to the publication of our paper, there was only one exception, which was exclusively represented by *Hyneria lindae* from the Catskill Formation in Pennsylvania (USA). Now we demonstrate that this genus also occurred in Gondwana, supporting a probable Gondwanan origin for the clade. It is also the only tristichopterid known from polar regions. Most of the other Gondwanan tristichopterids come from Australia, which was on the tropical northern coast of Gondwana and has a far better-understood fossil record. (Similarly, Laurasia was entirely situated within tropical and subtropical latitudes).

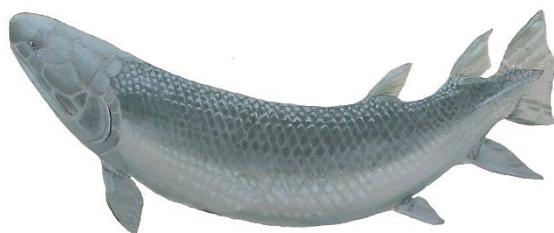


Fig. 2. Artist's reconstruction of *Hyneria udlezinye*.

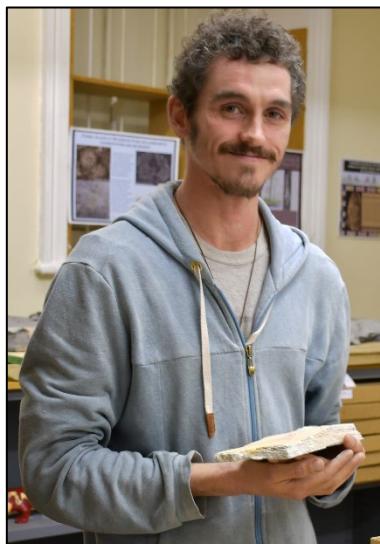


Fig. 3. Chris HARRIS, Ph.D. student

Chris HARRIS, Ph.D. student under Rob GESS' co-supervision (Fig. 3), is the lead author on a joint paper published in *Palaeos*. This provides a detailed analysis of a third significant Famennian fossil site within the Witpoort Formation near Makhanda (Grahamstown), one

of two discovered by Rob GESS during roadworks east of Makhanda in 2015. Like Waterloo Farm and Coombs Hill, this site comprised a black mudstone horizon within the Witpoort Formation, formed during flooding of the continental margin during a time of elevated sea level. It is, however, stratigraphically lower in the Witpoort Formation than either of the other two and represents a distinct environment, with a greater tidal marine input. In fact, it provides the stratigraphically highest record of marine invertebrates in the entire Cape Supergroup, the fossil component being almost entirely comprised of lingulid brachiopods. Rigorous analysis of the site by Chris has drawn on sedimentology, trace fossils, and less common fossil elements to create a detailed picture of this palaeoenvironment. This expands our knowledge of the latest Devonian coastline and sheds light on short-lived periods of sea-level rise during the latest Devonian that are notably associated, globally, with early pulses of the end-Devonian Mass Extinction. Analysis of the large recovered sample of lingulids also provides a valuable contribution to understanding of Palaeozoic lingulid populations and habitats. This forms part of his ongoing Ph.D. study on the geology, sedimentology and stratigraphy of the Witpoort Formation.



Fig. 4. Ph.D. student Ryan NEL, preparing placoderms.

Ryan NEL (Fig. 4) has made steady progress on his Ph.D. on South African placoderm fossils, including the large collection of material

from Waterloo Farm. In July 2023 he presented his work at the *Palaeo Down Under* conference in Perth, extending his visit to examine placoderm fossils housed in collections in Perth and Sydney; together with co-supervisor TM Kate TRINAJSTIC of Curtin University.



Fig. 5. M.Sc. student Cait REDDY, making a latex cast of an early ophiuroid.

Cait REDDY completed her B.Sc. honours dissertation in 2022, for which she received a distinction. This comprised a taxonomic analysis of early Devonian ophiuroid echinoderms from the uppermost Tabe Mountain Group performed under the dual mentorship of Robert GESS and Mhairi REID. With the assistance of Ben THUY, this study has been successfully prepared for publication. It provides the southern Hemisphere's earliest ophiuroid record, with one of the two species studied representing a new taxon. She continues in the lab in 2023 doing an M.Sc. dissertation on 'seaweed' fossils from Waterloo Farm.

Rob GESS, Chris HARRIS and Ryan NEL all presented their work at the biannual Palaeontology Society of South Africa conference in Golden Gate National Park in September 2022. This was a highly enjoyable conference. It is planned that for the 2024 conference, to be held in Graaf Reinet, South Africa a specific Early Palaeozoic/Cape Supergroup symposium will be incorporated into the proceedings.

In 2023 we have enjoyed collaborative visits from Brian CHOO (Flinders University, Australia) and CM Carole BURROW (Queensland Museum, Australia) to respectively work on actinopterygian and gyracanthid 'acanthodian' fossils from Waterloo Farm. In July to August 2023 Rob GESS had a very informative visit to Latvia, funded in part by the ERC Advanced Grant "Tetrapod Origin", which supports a tetrapod origin working group centred on Per AHLBERG's lab in Uppsala University. Rob GESS was hosted by CM Ervins LUKŠEVIČS at the University of Latvia, where he examined early vertebrate fossils. He and Per AHLBERG then joined Ervins LUKŠEVIČS' team on a two-week fieldtrip to excavate Famennian fossils from the Pavari 2 locality. This was productive, informative and extremely enjoyable.



Fig. 6. Excavations at Pavari 2, with Robert GESS and Ervins LUKŠEVIČS.

Publications

Papers

GESS, R. W. & AHLBERG, P. E. (2023). A high latitude Gondwanan species of the Late Devonian tristichopterid *Hyneria* (Osteichthyes: Sarcopterygii). - PLoS ONE, **18** (2): e0281333; <https://doi.org/10.1371/journal.pone.0281333>

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GESS, R.W. (2022b). Reconstruction of the high-latitude Late Devonian (Famennian) Waterloo Farm lägerstatte from the Witpoort Formation (Witteberg Group, Cape Supergroup) of South Africa. – In: Proceedings of the 21st Biennial Conference of the Palaeontological Society of Southern Africa, Golden Gate, September 12th – 15th, 2022. *Palaeontologia africana*: 55.

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

CM Sven HARTENFELS

Looking back, the year 2022 brought a significant career change for me. After 17.5 years as an employee of the universities of Münster and Cologne, the Geological Survey of North Rhine-Westphalia offered me a permanent position that I have accepted very gladly. As part of the department “mapping related palaeontology, mineralogy, and petrography”, I am responsible for the identification and biostratigraphic classification of conodont faunas as well as the analysis and environmental interpretation of carbonate microfacies, amongst others. Based on the long tradition of conodont workers at the survey (e.g., W. ZIEGLER, K. LEUTERITZ, M. PIECHA), we own an extensive conodont database, which

I will, of course, continue to maintain in the future.

One of the major goals in the last year was the bio- and lithostratigraphic dating of drill cores, which were sunk by the Geological Survey in the course of a deep geothermal characterisation of the subsurface of North Rhine-Westphalia. In this context, new insights into the early Mississippian Kohlenkalk Platform of the Aachen region were presented at the GeoBerlin 2023. In contrast to the nearby active Hastenrath Quarry, the Palaeozoic part of the investigated core Gressenich BK1 shows an inverted stratification. However, all formations and members of the drilled Kohlenkalk succession can be easily subdivided by lithostratigraphy. Considering the regional stratigraphic schemes in the Vesdre Massif of eastern Belgium and referring to the formal lithostratigraphic concept of AMLER & HERBIG (2006), these are the Vesdre and Terwagne formations. The latter contains the Hastenrath (= *Vaughanites* Oolite), Bärenstein, and Bernardshammer members. Unfortunately, conodonts are rare or absent. In the case of the *Vaughanites* Oolite, reworking processes cannot be ruled out.

Jointly with R. Thomas BECKER (Münster), members of the Devonian/Carboniferous Boundary Task group were guided to the DCB sections Borkewehr, Oese, and Dreher (all Rhenish Massif). Based on a multi-proxy study, the first has been proposed as a potential GSSP section by HARTENFELS et al. (2022). The paper is part of the special *Palaeobiodiversity and Palaeoenvironment* issue on “*The Rhenish Massif: More than 150 years of research in a Variscan mountain chain*” edited together with Christoph HARTKOPF-FRÖDER (Cologne) and Peter KÖNIGSHOF (Frankfurt am Main). A second part of this special issue is in preparation and will be published again in *Palaeobiodiversity and Palaeoenvironment* in September 2023.

In cooperation with Helge MIßBACH-KARMRODT (Cologne), B.Sc. student **Adrian RÜHL** (Cologne) was supervised, who worked

on a carbonate microfacies analysis of the so called “Plattenkalk” of the Bergisch Gladbach-Paffrath Syncline. Of course, I continued to collaborate with R. Thomas BECKER, Zhor Sarah ABOUSSALAM and David DE VLEESCHOUWER (all at Münster), Dieter WEYER (Berlin), Christoph HARTKOPF-FRÖDER, Peter KÖNIGSHOF, Markus ARETZ (Toulouse), and my colleagues from Belgium and Italy, amongst others.

Publications

Journal papers

HARTENFELS, S., HARTKOPF-FRÖDER, C. & KÖNIGSHOF, P. (2022a). The Rhenish Massif: More than 150 years of research in a Variscan mountain chain. – *Palaeobiodiversity and Palaeoenvironments*, **102** (3): 493–502.

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HERBIG, H.-G., AMLER, M. R. W., ARETZ, M. & HARTENFELS, S. (2022). Special Issue: 19th International Congress on the Carboniferous and Permian, Cologne 2019. Palaeontological contributions. – *Paläontologische Zeitschrift*, **96** (3): 403–407.

RAKOĆIŃSKI, M., KUCHARCZYK, J., PISARZOWSKA, A., ZATOŃ, M., MARYNOWSKI, L., HARTENFELS, S. & BECKER, R. T. (2023). Redox changes and mercury signature during the Lower Alum Shale Event (mid-Tournaisian, Mississippian) in the Rhenish Massif: Implications for oxygenation history and volcanism in southern Laurussian shelf and Palaeotethys Ocean. – *Global and Planetary Change*, **227**: 104165.

STICHLING, S., BECKER, R. T., HARTENFELS, S., ABOUSSALAM, Z. S. & MAY, A. (2022). Drowning, extinction, and subsequent facies development of the Devonian Hönne Valley Reef (northern Rhenish Massif, Germany). – *Palaeobiodiversity and Palaeoenvironments*, **102** (3): 629–696.

Editorials

HARTENFELS, S., HARTKOPF-FRÖDER, C. & KÖNIGSHOF, P. (eds., 2022). The Rhenish Massif: More than 150 years of research in a Variscan mountain chain. – *Palaeobiodiversity and Palaeoenvironments*, **102** (3): 493–829.

HERBIG, H.-G., AMLER, M. R. W., ARETZ, M. & HARTENFELS, S. (eds., 2022). Special Issue: 19th International Congress on the Carboniferous and Permian, Cologne 2019. Palaeontological contributions. – *Paläontologische Zeitschrift*, **96** (3): 403–612.

Abstracts

ABOUSSALAM, Z. S., BECKER, R. T., HARTENFELS, S. & EL HASSANI, A. (2023). Devonian conodont stratigraphy and facies development of the Azrou region (eastern part of western Moroccan Meseta). – Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks, Geneseo, New York, 27 July – 06 August 2023, Program and Abstracts: 14-15.

BECKER, R. T., ABOUSSALAM, Z. S., SAUPE, F. & HARTENFELS, S. (2023) Givetian to Tournaisian substages – significance, multi-disciplinary approaches, and GSSP potential in the Rhenish Massif (Germany). – GeoBerlin 2023. Geosciences Beyond Boundaries – Research, Society, Future, 150th PGLA (BGR) Anniversary and 175th DGGV Anniversary, 3 – 7 September 2023 [www.geoberlin2023.de].

HARTENFELS, S. & BECKER, R. T. (2022). The evolution of early protognathids and their significance for the redefinition of the Devonian/Carboniferous Boundary. 93. Jahrestagung der Paläontologischen Gesellschaft. Sep. 19th to 23rd at the Staatliches Museum für Naturkunde Stuttgart, Abstract volume: 18.

HARTENFELS, S., SALAMON, M. & HEß, O. (2023). Borehole Gressenich BK1: new insights into the early Mississippian Kohlenkalk Platform of the Aachen region, Germany. – GeoBerlin 2023. Geosciences Beyond Boundaries – Research, Society, Future, 150th PGLA (BGR) Anniversary and 175th DGGV Anniversary, 3 – 7 September 2023 [www.geoberlin2023.de].

SANDMANN, S., BECKER, S., STICHLING, S. & HARTENFELS, S. (2023). Lithostratigraphic mapping of Palaeozoic units in the northern

Rhenish Slate Mountains and the contribution of LithoLex. – GeoBerlin 2023. Geosciences Beyond Boundaries – Research, Society, Future, 150th PGLA (BGR) Anniversary and 175th DGGV Anniversary, 3 – 7 September 2023 [www.geoberlin2023.de].

CM Stephan HELLING

was “out of service” for a long time because of a field accident in which he injured both knees. He is working full-time for the Landschaftsverband Rheinland, LVR, Amt für Bodendenkmalpflege im Rheinland, Section Palaeontology and Geoarchaeology. This leaves limited time for his Devonian trilobite studies. He has been asked to contribute a review on the Rhenish Devonian trilobite successions for a multi-authored contribution on the biostratigraphy of all relevant fossil groups, to be submitted to a second Rhenish volume in *Palaeobiodiversity and Palaeoenvironments*. But other Devonian trilobites, e.g. from Morocco, are not forgotten.

CM Rodrigo Scalise HORODYSKI and other Brazilian workers

Studies of Organic Geochemistry, Palynology, Biostratigraphy, Paleogeography, Paleoclimatology, Paleoecology, Paleoceanography, Paleoenvironments, Petroleum System, Biomarkers, Taxonomy and Bioevents from Brazilian Devonian basins were developed in 2023. I highlight the paper of ROCHA et al (2023). The authors recognized that the changes detected in the physicochemical conditions of the depositional palaeoenvironment of the Ponta Grossa Formation (Early-Middle Devonian), East Gondwana, were correlated with significant biotic crises that preceded the great Devonian extinction event (Frasnian-Famennian), culminating in the extinction of the Malvinokaffric fauna. The study identified Zlíchov, Daleje, Chotěč, and Kačák Events through geochemical analyses and corroborated previous studies by BOSETTI et al. (2011),

HORODYSKI et al. (2014), and SEDORKO et al. (2019).

Devonian publications 2011-2023

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- GAIA, G., RIBEIRO, V. R., GHILARDI, R. P., SOUSA, F. N., LLOPART, M. P. & RICARDI-BRANCO, F. (2023). Chemical and elementary characterization of *Spongiophyton nanum*: Understanding the phylogeny, paleoenvironment, and fossilization processes of an enigmatic flora. - *Review of Palaeobotany and Palynology*, **316**: 104943.
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- & LIMA FILHO, M. (2023). Ichnology in storm and fair-weather beds of an epeiric sea (Pimenteira Formation, Devonian, Brazil). - Journal of South American Earth Sciences, **122**: 104162.
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- ROCHA, L. R., DE SOUZA, E. S., RIBEIRO, H. J. P. S., FRANCO, D. M. M., COVAS, T., VAZ, B. G. & DA CRUZ, G. F. (2023). Detection of Early-Middle Devonian biotic crises in East Gondwana, Paraná Basin, Brazil: An organic geochemical approach. - Organic Geochemistry, **181**: 104629.
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CM Heiko HÜNEKE

Present studies focus mostly on the sedimentology of Devonian cephalopod limestones in the eastern Anti-Atlas and in the High Atlas of Morocco. This work is in collaboration with Moroccan colleagues

Ahmed EL HASSANI (Rabat), Lahssen BAIDDER (Casablanca) and German colleagues Zhor Sarah ABOUSSALAM, and Ralph Thomas BECKER (both Münster). The Moroccan Taiflalt Platform is recognized as part of a contourite depositional system, namely a contourite terrace at the uppermost slope that connected the epicontinental sea of Gondwana with the Meseta domain further north. The identified bioclastic carbonate drift is one of the rare fossil analogues of modern carbonate contourites that was formed under greenhouse climate conditions. The contourite interpretation is based on a comprehensive biostratigraphic data base and independent lines of sedimentological evidence at the microfacies, bed, drift and basin scale.

Publications

Paper

ABOUSSALAM, Z. S., BECKER, R. T., HARTENFELS, S. & EL HASSANI, A. (2023). Devonian conodont stratigraphy and facies development of the Azrou region (eastern part of western Moroccan Meseta). - In: OVER, D. J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks, Geneseo, New York, 27 July – 06 August 2023, Program and Abstracts: 14-15.

Abstracts

GIBB, M. A., HÜNEKE, H., MEHLHORN, P., GIBB, L. M., ABOUSSALAM, Z. S., BECKER, R. T., EL HASSANI, A. & BAIDDER, L. (2023a). Frasnian contourite channel-drift system: Dense shelf-water cascading of anoxic water from the northern Gondwana Epeiric Sea (Taiflalt, Morocco). -Meeting, 4th Deepwater Circulation Research Conference, Edinburgh, May 24-26, 2023 [talk].

HÜNEKE, H., GIBB, M. A., GIBB, L. M., KNIEST, J. F., MAYER, O., MEHLHORN, P., RICHTER, C., ABOUSSALAM, Z. S., BECKER, R. T., EL HASSANI, A. & BAIDDER, L. (2022). Sedimentary processes and deposits associated with gateways: a perspective from the ancient sedimentary record. -Meeting, The Geological Society, Oceanic gateways: modern and ancient analogues and their conceptual and economic implications, London, November 23-25, 2022 [talk].

HÜNEKE, H., GIBB, A., MEHLHORN, P., GIBB, L. M., ABOUSSALAM, Z. S., BECKER, R. T., EL HASSANI, A. & BAIDDER, L. (2023b). Facies variability and depositional architecture of bioclastic bottom-current deposits formed on a Devonian contourite terrace (Tafilelt Platform, Morocco). – Meeting, 4th Deepwater Circulation Research Conference, Edinburgh, May 24-26, 2023 [poster].

TM Ulrich JANSEN

The studies on latest Silurian to earliest mid-Devonian brachiopods from the Rhenish Massif have been continued. Apart from the taxonomic work, brachiopod biofacies and palaeoenvironment have been studied. Another focus was put on the correlation of the traditional basal Emsian boundary. On a field trip to the Middle Rhine and SE Eifel regions in July, additional material from the Emsian was collected. Recent results were presented at the SDS 2023 and IGCP 652 Annual Meeting in Geneseo, N.Y. After the meeting I visited the collections of the Paleontological Research Institution in Ithaca (PRI), N.Y., and the New York State Museum in Albany, N.Y. for comparative studies. At present, an overview work on the Devonian–Carboniferous brachiopods from the Rhenish Massif is under way (in cooperation with B. MOTTEQUIN).

Devonian activities also concerned the German Subcommission on Devonian Stratigraphy: together with colleagues I have co-organised the annual meeting in Plettenberg and guided an excursion in the Palaeozoic of the Ebbe Anticlinorium (Sauerland).

For the forthcoming book on the Central European Variscides (U. LINNEMANN, ed.), four chapters have been finalised in cooperation with colleagues (see below). For the chapter on the Hunsrück Slate (JANSEN & SCHINDLER, 2023 in press) a detailed stratigraphic review of this famous unit and its correlates in the Rhenish Massif has been conducted.

Publications

JANSEN, U., HALAMSKI, A. T. & MOTTEQUIN, B. (2023a in press): Silurian to Lower

Carboniferous brachiopods of Central Europe – palaeogeographic and palaeobathymetric constraints. - In: LINNEMANN, U. (ed.), The Geology of the Variscan Orogen in Central and Eastern Europe – from the margin of Gondwana to the center of Pangea. Regional Geology Reviews; Berlin (Springer).

JANSEN, U. & SCHINDLER, E. (2023b in press): Fossils and age of the Hunsrück-Schiefer – a unique taphonomic window in the Lower Devonian of the Rheinisches Schiefergebirge (Germany). - In: LINNEMANN, U. (ed.), The Geology of the Variscan Orogen in Central and Eastern Europe – from the margin of Gondwana to the center of Pangea. Regional Geology Reviews; Berlin (Springer).

KÖNIGSHOF, P., JANSEN, U., LINNEMANN, U. & MENDE, K. (2023a in press): The Rhenohercynian Zone – an introduction. In: LINNEMANN, U. (ed.), The Geology of the Variscan Orogen in Central and Eastern Europe – from the margin of Gondwana to the center of Pangea. Regional Geology Reviews; Berlin (Springer).

KÖNIGSHOF, P., JANSEN, U., LINNEMANN, U. & MENDE, K. (2023b in press): The Rhenish Massif. - In: LINNEMANN, U. (ed.), The Geology of the Variscan Orogen in Central and Eastern Europe – from the margin of Gondwana to the center of Pangea. Regional Geology Reviews; Berlin (Springer).

Abstract

JANSEN, U. (2023): Revision of latest Silurian–Mid-Devonian brachiopod faunas from the Rhenish Massif (Germany): state of the art and perspectives. – In: OVER, D.J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652, Geneseo, New York, Reading geologic time in Paleozoic sedimentary rocks Geneseo, New York, 27 July – 06 August 2023 Program and Abstracts: 52–53.

CM Peter KÖNIGSHOF

The focus of the year 2022 and 2023 was and is on the Central Asian Orogenic Belt (CAOB). In July and August last year, a three weeks-lasting expedition took place to the southern Gobi. More than 500 kg rock samples were taken from the southern Gobi area (Shine Jinst

region). The studied region records a complex interaction of sedimentation, regional tectonics, sea-level changes and coeval volcanism. Based on our first results, it seems likely that the number of terranes in that area requires a revision and that the Devonian/Carboniferous transition in the entire region is characterized by an unconformity, which is similar to other areas in Mongolia, such as the Mondalovoo-Gurvansayhan Terrane. Furthermore, we will provide an improved biostratigraphic frame of this area (work in progress). A first report will be submitted at the end of this year. Other research concentrated on sections in the Rhenish Massif, where reef limestones particularly in the southern Rhenish Massif

have been studied (see references). Other activities concern studies on the Devonian scolecodonts, a joint project with Petra TONAROVA (Czech Republic), which is sponsored by the Science Foundations of the Czech Republic and Germany (CAČR – DFG cooperation).

The 6th International Palaeontological Congress (IPC6, Mahasarakham), which took place from November 7th to 11th 2022 in Khon Kaen, Thailand was co-organized. The very well organized and successful conference also included a Special Session on the Devonian and related IGCP Projects (IGCP 700) with a good number of contributions and vivid discussions.



Fig. 1. Opening Ceremony of the 6th Palaeontological Congress, Khon Kaen, Thailand.

Pre-conference, mid-conference and post-conference excursions were organized, which took the participants to classical localities in Thailand, such as the Satun Geopark or the Khorat Plateau.

The Special Issue on the “Rhenish Massif” in collaboration with Christoph HARTKOPF-FRÖDER and Sven HARTENFELS (eds.) was published in September 2022

(*Palaeobiodiversity and Palaeoenvironments*, vol. 102). Due to the large number of additional contributions, a second part is in progress and will be published in the same journal.

Publications

HARTENFELS, S., HARTKOPF-FRÖDER, C. & KÖNIGSHOF, P. (2022). The Rhenish Massif: More than 150 years of research in a Variscan mountain chain. - *Palaeobiodiversity and*

- Palaeoenvironments, **102**: 493–502; <https://doi.org/10.1007/s12549-022-00546-y>.
- HARTENFELS, S., HARTKOPF-FRÖDER, C. & KÖNIGSHOF, P. (eds., 2022) The Rhenish Massif: More than 150 years of research in a Variscan mountain chain. - Palaeobiodiversity and Palaeoenvironments, **102**: 493–829.



Fig. 2. Participants visiting the Satun Geopark, Peninsular Thailand, with excursion leader Clive BURRET in the middle right.

LAZREQ, N., HASSAN, B., BOUARI, A., ABDERRAHMANE, S., ESSAIF, A. & KÖNIGSHOF, P. (2023). New biostratigraphic evidence of Upper Devonian deposits by metamorphosed conodonts from Sidi Bou-Othmane area of Central Jebilet, Morocco and their palaeogeographic implications. - Journal of African Earth Sciences, **205**; <https://doi.org/10.1016/j.jafrearsci.2023.105007>.

KÖNIGSHOF, P., LOOS, S. & J. RUTKOWSKI (2023). Lithofacies variability and facies analysis of a Givetian reef in the southwestern Lahn Syncline (Rhenish Massif, Germany). – In: HARTENFELS, S., HARTKOPF-FRÖDER, C. & KÖNIGSHOF, P. (eds.), The Rhenish Massif: More than 150 years of research in a Variscan mountain chain – Part II. Palaeobiodiversity and Palaeoenvironments; <https://doi.org/10.1007/s12549-023-00585-z>.

STRIBRNÝ, B., KORN, D., KÖNIGSHOF, P., ERBACHER, J. & BLUMENBERG, M. (2023 in press). Die Kupfererzlagerstätte Marsberg. - Geologisches Jahrbuch, Reihe A, **166**.

KÖNIGSHOF, P. & FLICK, H. (2023 in press). Fringing reef growth in the mid-Devonian: An example from the Rhenish Massif, Germany. - In: HARTENFELS, S., HARTKOPF-FRÖDER, C. & KÖNIGSHOF, P. (eds.), The Rhenish Massif: More

than 150 years of research in a Variscan mountain chain – Part II. Palaeobiodiversity and Palaeoenvironments.

CM Tomáš KUMPAN

My research continued on several topics listed in the previous report. They were mainly related to material from the Upper Devonian of the Moravian Karst, Czechia. One of the topics was sedimentology and geochemistry of micrites from the Frasnian, Famennian and Tournaisian micritic limestones. Work on the manuscript focused on the *in-situ* element geochemistry and its paleoredox implications for microbial-rich Frasnian/Famennian limestone succession is in progress. I have also supervised several theses aimed to conodont biostratigraphy and carbonate sedimentology of Famennian sequences of the Líšeň Formation between the boundary events (**Štěpán DAMBORSKÝ** – stratigraphy of thick calciturbiditic sequence; **Sára KOZÁKOVÁ** – upper slope hemipelagic sequence; **Marek BERNHAUSER** – transitional facies). New bulk geochemical data were obtained for study of Frasnian-Famennian section Beringhauser Tunnel, Germany (co-operation with Thomas BECKER et al.) and laser-ablation dataset from Famennian-Tournaisian section in Crane Park quarry, Colorado (co-operation with Jeff OVER).

TM John E. A. MARSHALL & the Southampton Group

This last year has been busy as regards fieldwork. We have been to the Cantabrian Mountains and coastal sections in Asturias in Spain for two further visits. This is a NERC funded grant led by Charlie WELLMAN from Sheffield and includes David BOND (Hull) on the stable isotopes and geochemical indicators of extinction together with **Gilda LOPES** as the post-doc focusing on the acritarchs and chitinozoans. Some of these sections are very well known having been studied by CRAMER in the 1960's at the very beginning of palynology.

We have been greatly assisted in our sample collection by our local Project Partners Javier SANZ-LÓPEZ and Silvia GARCÍA-LÓPEZ, who some of you may remember from various conodont meetings.

For a month in July and August of 2022 I was back to East Greenland on a Swedish expedition led by Per AHLBERG from Uppsala and focusing on tetrapods and fish at the D-C boundary. This is funded by the ERC. Many new and interesting tetrapod specimens were found at a high level in the Devonian about which I know nothing. I drilled a shallow core through the D-C boundary terrestrial extinction lake on Celsius Bjerg together with sampling a continuous series of large blocks. These are now being analysed at sub centimetre level for palynology, $\delta^{13}\text{C}_{\text{TOC}}$, TOC, BSEM fabric etc. to better understand the terrestrial extinction and spore malformation. Interesting results are being revealed. The good news is that we will return to the sections in the summer of 2024.

In the late summer of 2023 I returned to the Devonian of Svalbard with Chris BERRY (Cardiff) and our Ph.D. student Amy WYATT to collect more fossil plants and make further images of the lycopod and *Archaeopteris* forests. Important new plant bits were found!

Conference attendance included The *International Palaeontological Congress* in Khon Kaen, STRATI23 in Lille, and the *Life and the Planet* Earth System meeting in London. Sadly, I was not able to attend the much awaited formal SDS meeting in NYS.

Publications

MARSHALL, J. E. A., MANGERUD, G., BRINGUÉ, M. & BUJAK, J. (2022). Devonian palynoevents in the circum-Arctic region. - *Atlantic Geoscience*, **5**: 307-328.

OWENS, B., MARSHALL, J. E. A., TELNOVA, O. P. & WELLMAN, C. H. (2022). Morphological relationships of *Ancyrospora* species from the Givetian and Frasnian deposits of the Pan-Arctic Region. - *Paleontological Journal*, **56**: 58-80.

REEVES, E., MARSHALL, J. E. A., BENNETT, C., DAVIES, S., KEARSEY, T. & MILLWARD, D. (2022). Historic palaeobotanical collection

reveals in situ microspores and pollen from Early Carboniferous (Tournaisian) ovules from the Ballagan Formation of Scotland - Review of Palaeobotany and Palynology, **308**: 104788.

SMART, M. S., FILIPPELLI, G., GILHOOLY III, W.P., MARSHALL, J. E. A. & WHITESIDE, J. H. (2022). Enhanced terrestrial nutrient release during the Devonian emergence and expansion of forests: Evidence from lacustrine phosphorus and geochemical records. – *Bulletin of the Geological Society of America*, B36384.1.

CM Atike NAZIK and the Turkish Group

I continue to work on Devonian ostracods from different sections of NW Anatolia, the Central and Eastern Taurides in Turkey. In addition, I am investigating Devonian ostracods of shallow-water sections from Iran and Mongolia together with CM Peter KÖNIGSHOF. Turkish and German Colleagues prepared two presentations dealing with the Devonian from the Eastern Taurides (SCHINDLER et al. 2022; YALÇIN et al. 2022) and these oral presentations were presented at the 2nd Symposium on Geology of the Taurus Belt, Ankara, Turkey. A manuscript on Givetian ostracods and conodonts from the İstanbul zone was prepared (A. NAZIK with Ş. ÇAPKINOĞLU, E. OLEMPSKA, N. ÖZGÜL, and E. ŞEKER ZOR) and It was submitted.

Dr. Emine ŞEKER from Çukurova University is working on Devonian ostracods from Kozan and Karaisalı (Adana, Southern Turkey) together with A. NAZIK.

Dr. Gülnur SAYDAM-DEMIRAY from Ankara focuses on Devonian conodonts in MTA (Mineral Research and Exploration) projects.

Assoc. Prof. Dr. Ayşe ATAKUL-ÖZDEMİR (Van Yüzüncü Yıl University) focuses on conodont biostratigraphy. Her current project (with colleagues Demir ALTINER, Aral OKAY, Sevinç Özkan ALTINER, Yavuz ÖZDEMİR, and Türker YAKUPOĞLU) concerns the evaluation of upper Paleozoic carbonates exposed around the east of Lake Van and Ağrı Doğubayazıt on the basis of stratigraphic and paleontological data,

and the contributions to the paleogeographic and tectonic evolution of the region.

Consulting Dr. İzzet HOŞGÖR continues research on Devonian macrofossils from the Arabian Plate, Southeastern Anatolia, Turkey. He is recently studying Lower Devonian bivalves from the Arabian Plate, SE Turkey.

Dr. Recep ÖZKAN is a foraminiferal micropaleontologist from the Turkish Petroleum Co. (TPAO) in Ankara, Turkey. He was recently involved in a new project focused on Devonian rocks in southeast Anatolia, Turkey.

Dr. Tuba AYDIN ÖZBEK is a biostratigrapher (palynology) from the Turkish Petroleum Co. (TPAO). She finished her Ph.D. Thesis titled “*Palynostratigraphy of the Middle Devonian-Lower Carboniferous Successions in Central and Eastern Taurides, Turkey*” in 2023 (supervisor was Prof. Dr. Sevinç ÖZKAN-ALTINER from the Middle East Technical University). She was recently involved in a new Project (TPAO) focused on the palynostratigraphy of Devonian rocks in southeast Anatolia, Turkey.

Sinem TANRIKULU is a palynologist from the Turkish Petroleum Corporation. She continues her Ph.D. thesis titled “*Palynology of the Uppermost Ordovician-Lower Devonian Deposits in Taurides, Turkey: Taxonomy, Biostratigraphy, Paleobiogeography and Sequence Stratigraphic Interpretations*”.

Publications

Papers

CRÔNIER, C. & HOŞGÖR, İ. (2022). A preliminary account on Devonian trilobites from the Arabian Plate, SE Turkey. - Turkish Journal of Earth Sciences, **31** (5): 467-479; <https://doi.org/10.55730/1300-0985.1814>.

ÖZKAN, R. (2022). Devonian parathuramminids from Taurides, southern Turkey. - Turkish Journal of Earth Sciences, **31**: 1-25.

Abstracts

ATAKUL-ÖZDEMİR, A., TÜRKMENOĞLU-GÜNAL, A., GÖNCÜOĞLU, M. C., BOZKAYA, Ö. & OKUYUCU, C. (2022). Conodont biostratigraphy of the upper

Frasnian-lower Famennian deposits in the Istanbul-Zonguldak Terrane, NW Turkey: Evidence for the Upper Kellwasser Event. – In: ICOS 5, Wuhan, China.

YÜCEL, Ö., GÜNAL TÜRKMENOĞLU, A. & ATAKUL-ÖZDEMİR, A. (2023). Fingerprints of F-F (Frasnian-Famennian) Boundary within Yılanlı Formation (Late Devonian-Early Carboniferous) K-Bentonites in North-western Black Sea Region, Turkey. - In: 19. Clay Symposium, Eskisehir, Ankara.

AYDIN ÖZBEK, T., ALTINER, S. & ALTINER.D. (2022). Palynostratigraphy of Givetian-lower Famennian Deposits in the Central and Eastern Taurides (Türkiye). - In: 2nd Symposium on Geology of The Taurus Belt, 28-30 November 2022, Abstract Book: 98-99.

MUNKHJARGAL, A., KÖNIGSHOF, P., WATERS, J. A., CARMICHAEL, S. K., GONCHIGDORJ, S., NAZIK, A., CRÔNIER, C., UDCHACHON, M., THASSANAPAK, H., ROELOFS, B., DUCKETT, K. & FORONDA, J. (2023). Late Devonian to Early Carboniferous Intervals (D/C Transitions) From Mongolia: Insights from Two Different Terranes. - In: OVER, D. J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks. 27 July – 06 August 2023, Geneseo, New York, Program and Abstracts: 59-60.

SCHINDLER, E., YALÇIN, M. N., WILDE, V., NAZIK, A., WEHRMANN, A., ÖZKAN, R., YILMAZ, İ., BROCKE, R., BOZDOĞAN, N., JANSEN, U. & SAYDAM-DEMIRAY, G. (2022). Global Events in the Devonian of the Taurides: Analyses and Comparison within an Event-Stratigraphical Framework. – In: 2nd Symposium on Geology of the Taurus Belt, 28-30 November 2022, Abstract Book: 16-17.

TANRIKULU, S., ÖZKAN-ALTINER, S. & ALTINER, D. (2022). Lochkovian (Lower Devonian) palynomorph assemblages of the Eastern Taurides, Turkey. - In: 11th European Palaeobotany and Palynology Conference, Abstracts, Program and Proceedings: 177.

YALÇIN, M. N., SCHINDLER, E., NAZIK, A., WILDE, V., WEHRMANN, A., ÖZKAN, R., YILMAZ, İ., BROCKE, R., KOZLU, H., JANSEN, U. & EROĞLU, G. (2022). Burial History of Gondwanan Devonian Successions in the Eastern and Central Taurides, Turkey. – In: 2nd Symposium on

Geology of the Taurus Belt, 28-30 November 2022, Abstract Book: 80-81.

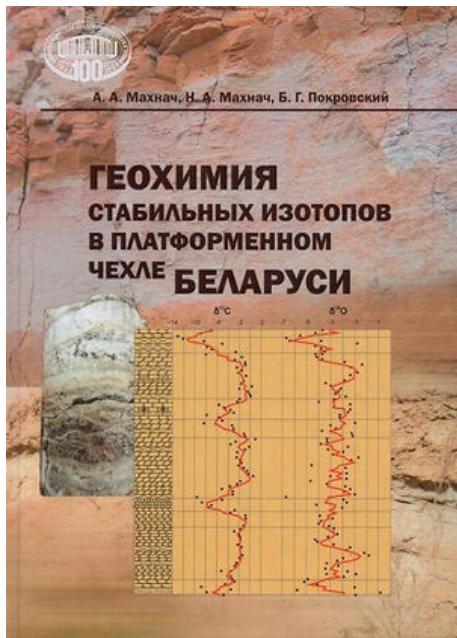
CM Dmitry P. PLAX and the Belarusian Devonian Group

The Belarusian Devonian group includes researchers at the Institute of Geology, Branch of the State Enterprise «Research and Production Center for Geology», and the Belarusian National Technical University (D. P. PLAX).

In 2022–2023 members of the Group continued studying different aspects (mostly stratigraphic, paleontological, lithological, geochemical, etc.) of the Devonian of Belarus. Publications of research results are presented below.

Two new books deal at least partly with Devonian strata:

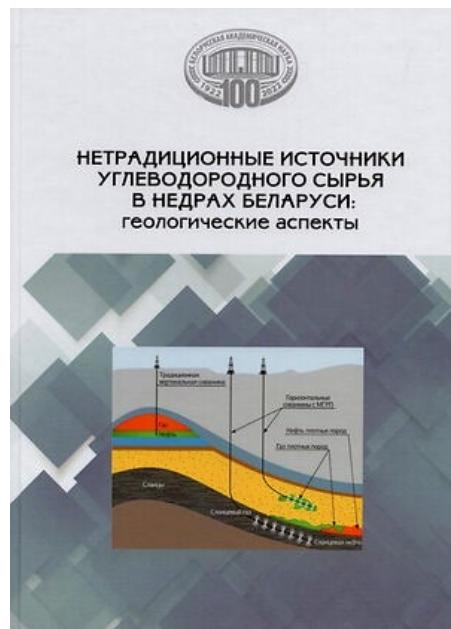
МАХНАЧ, А., МАХНАЧ, Н. & ПОКРОВСКИЙ В. (2022). Geochemistry of stable isotopes in the platform cover of Belarus. – 373 pp., Belorusskaia nauka; ISBN 978-985-08-2823-1 [in Russian].



The monograph includes materials on the geochemistry of stable isotopes of carbon, oxygen and sulfur of the Belarus platform, obtained over the past thirty years. The isotope chemostratigraphy of a number of sections is

characterized, and the description of isotopic indicators developed by the authors in relation to the settings of sedimentation and genesis of deposits from the Riphean to the Quaternary is given. Possibilities of isotope tracers for palaeogeographic, palaeoclimatic, and palaeohydrological reconstructions, and the solution of geoecological problems are shown. A large source of analytical material is presented.

AIZBERG, R. & GRIBIK, Y. (eds., 2022). Unconventional sources of hydrocarbon raw materials in the depths of Belarus: geological aspects. – 332 pp., Belorusskaia nauka; ISBN 978-985-08-2827-9 [in Russian].



The paper presents an assessment of the potential of unconventional sources of hydrocarbons in Belarus, directions of geological exploration for the future based on the analysis of geological, geophysical, and geochemical data in the Pripyat, Orsha, Podlasie-Brest basins, and the study of the structural and material characteristics of low-permeability formations with scattered (discrete) bitumen content, as well as structures with heavy oils. Scientific conclusions are given regarding the wide development of low-permeability oil-promising semi-reservoirs in the Devonian deposits of the Pripyat Trough.

Other publications

Journal papers

- TOLSTOSHEEV, V., KRUCHEK, S. & SAKHARUK, P. (2022). Structural characteristics of the surface of the Upper Devonian Frasnian deposits of the Bragin-Loyev bridge and adjacent territories (southeast of Belarus). – *Litasfera*, **56** (1): 3–19 [in Russian, with English summary].
- STRELTSOVA, G., KUZMENKOVA, O., LAPTSEVICH, A., MANKEVICH, S., ASHURKO, V., GLAZ, N., KARIMOVA, L., KRUCHEK, S., TOLSTOSSHEEV, V. & OBUKHOVSKAYA, V. (2022). Results of deep geological mapping at a scale of 1:200 000 of the territory of the topo sheets N-36-XIX (Mogilev), N-36-XXV (Zhlobin), N-36-XXXI (Gomel) and N-36-XXXII (Dobrush) (platform cover). – *Litasfera*, **57** (2): 3–8 [in Russian, with English summary].
- MAKHNACH, A., POKROVSKY B. & MURASHKO, O. (2022). Variations of the carbon and oxygen isotopic composition in the Emsian-Frasnian deposits of the North Pripyat shoulder (southeast of Belarus). – *Litasfera*, **57** (2): 101–115 [in Russian, with English summary].
- PLAX, D. P. (2022). Ichthyofauna from the Lower Devonian (Lochkovian) deposits of the Podlasie-Brest Depression (from the results of the Rataichitsy 12k borehole section investigation). – *Natural resources*, **1**: 44–66.
- PLAX, D. P. & NEWMAN, M. J. (2022). Placoderm remains from the Middle Devonian of Belarus. – *Fossil Record* 8. New Mexico Museum of Natural History and Science Bulletin, **90**: 331–337.
- MAKHNACH, A., POKROVSKY, B. & MURASHKO, O. (2023). Carbon and oxygen isotopes in the Middle Eifelian deposits of Belarus. – *Litasfera*, **58** (1): 111–129 [in Russian, with English summary].
- PLAX, D. P. & MELNIKOV, V. V. (2023). On the findings of the redeposited Devonian ichthyofauna remains in the Quaternary deposits in the surroundings of Mogilev. – *Litasfera*, **58** (1): 155–158 [in Russian].
- PLAX, D. P. & BAHDASARAU, M. A. (2023). Stratigraphy and ichthyofauna of the Upper Emsian-Givetian deposits in the section of the Klimovichi 4p borehole (Mogilev region, Belarus). – *Nature management*, **1**: 151–172.

Abstracts

PLAX, D. P. (2022). Ichthyofauna from the Lower Devonian (Lochkovian) deposits of the Brest region, Belarus. – In: Palaeontology and stratigraphy: current state and ways of development. Proceedings of the LXVIII session of the Palaeontological Society at the Russian Academy of Sciences, dedicated to the 100th anniversary of the birth of Alexander Ivanovich ZHAMOIDA, St. Petersburg, 25–29 Apr. 2022: 232–234 [in Russian].

PLAX, D. P. & LUKŠEVIČS, E. (2023). A new antiarch fish (Placodermi) from the Lower Devonian Vitebsk Formation of Belarus. – In: Natural sciences. Geology, Geophysics & Palaeontology. Abstracts of the 81st International Scientific Conference of the University of Latvia, Riga, 9–10 Feb. 2023: 42–44.

PLAX, D. P. (2023). Ichthyofauna from the Lower and Middle Devonian deposits of the Klimovichi 4II parametric borehole (Mogilev region, Belarus). – In: Bio- and geoevents in the history of the Earth. Stages of evolution and stratigraphic correlation. Proceedings of the LXIX session of the Palaeontological Society at the Russian Academy of Sciences, St. Petersburg, 3–7 Apr. 2023: 127–129 [in Russian].

CM Eberhard SCHINDLER

2022 – the year of retirement (since 1 March 2022); still somewhat hard to believe! But as I am now an ‘Appointed Honorary Worker’ at Senckenberg, I can continue working on scientific projects (e.g., that have not yet been brought to an end – or at least to some stage of “ripeness” – as well as new ones).

One of these older items was published late in 2022 – a “monster” on latest Emsian ostracods from the Moroccan Anti-Atlas together with a number of colleagues (see GROOS-UFFENORDE et al. 2022).

Ongoing output results from our Turkish-German cooperation projects – two talks were given on Devonian subjects of the Taurides (see SCHINDLER et al. 2022; YALÇIN et al. 2022); further papers are in preparation (e.g., on the first Turkish scyphocrinoids with Reimund HAUDE and others).

A book chapter in Ulf LINNEMANN's 'monster volume' on the Variscan Orogeny in Central and Eastern Europe dealing with various aspects of the famous Hunsrück-Schiefer is on its way authored by Uli JANSEN and myself. Work on the Eifel area will be revitalised together with colleagues from Germany and the US.

Studies on a probable leftover of the Ediacara Biota in Lower Devonian rocks of the Mosel area are still ongoing (one has to be very careful when dealing with the "shark basin" of Ediacaran specialists...). In this context, an "excursion" into the latest Precambrian (Ediacarian) resulted in a paper on *Pteridinium simplex* (see DARROCH et al. 2022). I am happy to announce that the senior author of that paper (Simon DARROCH) is going to fill my former position at Senckenberg starting on 1 September 2023.

Publications 2022

DARROCH, S. A. F., GIBSON, B. M., SYVERSEN, M., RAHMAN, I. A., RACIOT, R. A., DUNN, F. S., GUTARRA-DIAZ, S., SCHINDLER, E., WEHRMANN, A. & LAFLAMME, M. (2022). The life and times of *Pteridinium simplex*. – *Paleobiology*, **48** (4): 527-556. doi:10.1017/pab.2022.2

GROOS-UFFENORDE, H., SCHINDLER, E., BECKER, R.T., DOJEN, C., BROCKE, R. & JANSEN, U. (2022): Late Early Devonian ostracodes from the Torkoz area (SW Morocco) and the Emsian/Eifelian Boundary. – *Paläontologische Zeitschrift*, **96** (4): 689-747; doi.org/10.1007/s12542-022-00603-z

SCHINDLER, E., YALÇIN, M. N., WILDE, V., NAZIK, A., WEHRMANN, A., ÖZKAN, R., YILMAZ, İ., BROCKE, R., BOZDOĞAN, N., JANSEN, U. & SAYDAM-DEMIRAY, G. (2022). Global Events in the Devonian of the Taurides – Analyses and Comparison within an Event-Stratigraphical Framework. – In: 2nd Symposium on Geology of the Taurus Belt 28-30 November 2022, Abstract Book: 17.

YALÇIN, M.N., SCHINDLER, E., NAZIK, A., WILDE, V., WEHRMANN, A., ÖZKAN, R., YILMAZ, İ., BROCKE, R., KOZLU, H., JANSEN, U. & EROĞLU, G. (2022): Burial History of Gondwanan Devonian Successions in the Eastern and Central

Taurides, Turkey. – In: 2nd Symposium on Geology of the Taurus Belt 28-30 November 2022, Abstract Book: 81.

TM Ladislav Slavík and Czech CMs

Year 2023 is the last year of the "Pragian/Emsian boundary project" in the Prague Synform. Our team consisting of CM Jindra HLADIL, CM Tomáš WEINER and CM Hedvika WEINEROVÁ of the Institute of Geology of the Czech Academy of Sciences focused on the interpretation of data collected from the Bohemian Graptolite Event (BGE), i.e., the most important level and correlation horizon within the upper parts of the Praha Formation. During the last three years, extensive sets of geo-chemo-petrophysical and biostratigraphic data were obtained from the Praha Formation, i.e., the original Pragian Stage before the *kitabicus* GSSP definition. Data from four studied sections (Pod Barrandovem, Mramorka Quarry, Branžovy Quarry, and Požár 3 Quarry) were evaluated during late 2022 and early 2023 together with the last batch of samples for biostratigraphy. The section in the Mramorka Quarry was selected as a possible candidate for the GSSP redefinition, and a manuscript was submitted for publication.

In spring, collaboration with Chinese colleagues Jia-Yi YIN, Jian-Feng LU, JUAN MA, Yi-Long LIU, Rui-Wen ZONG, and Yi-Ming GONG started on the earliest Devonian conodonts from Xinjiang, NW China. A relatively rich conodont material was found to contain critical index markers for the S/D boundary definition, and a manuscript was submitted.

A joint paper with Katarína HOLCOVÁ and others on Early Palaeozoic microboring organisms in various substrates was finished and published in early 2023.

Publications

Journal papers (2022-2023)

FERRETTI, A., CORRIGA, M. G., SLAVÍK, L. & CORRADINI, C. (2022). Running Across the Silurian/Devonian Boundary Along Northern

Gondwana: A Conodont Perspective. - Geosciences, **12** (1): 1-26.

MANDA, Š., SLAVÍK, L., ŠTORCH, P., ČÁP, P. & TASÁRYOVÁ, Z. (2022 online). Division of Přídolí Series in Central Bohemia: graptolite and conodont biostratigraphy, faunal changes, and geochemical record. - Newsletters on Stratigraphy: 1-35.



Fig. 1. Sampling of the upper parts of the Praha Formation in section A in the Mramorka Quarry near Chýnice. Photo by H. WEINEROVÁ.

SPROSON, A. D., POGGE von STRANDMANN, P. A. E., SELBY, D., JAROCHOWSKA, E., FRÝDA, J., HLADIL, J., LOYDELL, D. K., SLAVÍK, L., CALNER, M., MAIER, G., MUNNECKE, A. & LENTON, T. M. (2022). Osmium and lithium isotope evidence for weathering feedbacks linked to orbitally paced organic carbon burial and Silurian glaciations. - Earth and Planetary Science Letters, **577** (117260): 1-13.

HOLCOVÁ, K., VACEK, F., ČÁP, P., BRUTHANOVÁ, J., SLAVÍK, L., MERGL, M., KRAFT, P., KERKHOFF, M. L. H. & CHADIMOVÁ, L. (2023 in press). Microboring organisms – an overlooked Early Palaeozoic marine ecosystem: Case study from the Prague Basin (Czech Republic). - Palaeoworld.

Abstracts

WEINEROVÁ, H., SLAVÍK, L., WEINER, T. & HLADIL, J. (2022). Pragian/Emsian Stage boundary: Searching for a new basal Emsian GSSP in the Prague Synform. - In: FEKETE, K. (ed.), 21st Slovak-Czech-Polish Paleontological Conference, Field Trip Guide and Abstracts Book; Bratislava, (St. Geol. Inst. D. Štúr), ISBN 978-80-8174-064-0.

SLAVÍK, L., WEINEROVÁ, H., WEINER, T. & HLADIL, J. (2022). Searching for a new basal Emsian GSSP in the Prague Synform – state of the art. – In: 6th International Palaeontological Congress, Khon Kaen, Thailand, November 7 – 11, 2022, Session 9 - Devonian palaeoenvironments and mass extinctions: 1 p.

WEINEROVÁ, H., SLAVÍK, L., WEINER, T., HLADIL, J. & MIKULÁŠ, R. (2023). Searching for a candidate section for the new basal Emsian GSSP in the Prague Synform. – In: VLAHOVIĆ, I. & MATEŠIĆ, D. (eds.), 36th International Meeting of Sedimentology, June 12–16, 2023, Dubrovnik, Croatia, Abstracts Book:4 43; Croatian Geological Society (HGD).

SLAVÍK, L., WEINEROVÁ, H., WEINER, T. & HLADIL, J. (2023). Basal Emsian GSSP – Possibilities in the Prague Synform. – In: OVER, D. J. (ed.), SDS Devonian Stratigraphy of New York State, Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks, Geneseo, New York, 27 July – 06 August 2023, Program and Abstracts: 66-67; Geneseo.

TM Claudia SPALLETTA

My research continues on conodont biostratigraphy and taxonomy, lithostratigraphy, and sedimentology of the Middle-Upper Devonian and lower Carboniferous rocks of the Carnic Alps. All these studies are made in collaboration with several co-authors, mainly Monica PONDRELLI and Carlo CORRADINI. I also continue studies on the Devonian-Carboniferous boundary within the activity of the International Task Group for the redefinition of the Devonian/Carboniferous Boundary (led by M. Aretz and C. CORRADINI). At last, after about two dozen of years, the paper on the Frasnian-

Famennian boundary in the Carnic Alps has been published, see list of publications.

Publications

CORRADINI, C., SIMONETTO, L., CORRIGA, M. G., PONDRELLI, M., PERRI, M. C. & SPALLETTA, C. (2023 in press). Stratigraphic sections in the La Valute-Chiarsò area (Mt Zermula, Carnic Alps, Italy). - Gortania - Geologia, Paleontologia, Planetologia, Museo Friulano di Storia Naturale di Udine; ISNN 2038-0410.

FARABEGOLI, E., PERRI, M. C., SPALLETTA, C., JOACHIMSKI, M. M., ANDREW, A. & PONDRELLI M. (2023). Physical and biological events across the Frasnian-Famennian boundary (Late Devonian) in continuous oxic carbonate successions in the western Tethys (Carnic Alps of Italy and Austria). - Bollettino della Società Paleontologica Italiana, **62** (2): 143-217; doi:10.4435/BSPI.2023.

PONDRELLI, M., LUCA SIMONETTO, L., CORRADINI, C., PERRI, M. C., CORRIGA, M. G. & SPALLETTA, C. (2023). The Pragian to Frasnian basin evolution in the Carnic Alps (Austria-Italy). In: Geology and Paleontology of Friuli and adjacent areas Workshop - Museo Friulano di Storia Naturale, Udine, 16-17 June 2023 - Abstract book: 35-38; ISBN 978 88 88192 73 4.

SPALLETTA, C., CORRADINI, C., SIMONETTO, L., CORRIGA, M. G., PERRI, M. C. & PONDRELLI, M. (2023). The Devonian sequence at the Mt Freikofel (Carnic Alps, Austria-Italy). – In: Geology and Paleontology of Friuli and adjacent areas, Workshop - Museo Friulano di Storia Naturale, Udine, 16-17 June 2023 - Abstract book: 57-60; ISBN 978 88 88192 73 4.

CM Thomas J. SUTTNER and Erika KIDO

We are happy to report that our Mongolian friend Byambajav UUGANTSETSEG defended her Ph.D. thesis some months ago, out of which one paper on Late Devonian conodonts from the Heermorit and Shombon members (Indert Formation, Shine Jinst area) is coauthored by Erika and me. Early in 2023, Erika and I started a joint study, initiated by Dieter WEYER, together with Dieter and Tomasz WRZOŁEK on late Frasnian corals age-calibrated by conodonts from the Harz Mountains. Besides that,

collaboration with Stana VODRÁŽKOVÁ and Jiri FRYDA continues.

Publication

SUTTNER, T.J., UUGANTSETSEG, B., ARIUNCHIMEG, YA., MANCHUK, N., KIDO, E., ERDENEJARGAL, C., BUYANTEGSH, B., ENKHBAATAR, B. & ZORIG, E. (2023, online first) Case study on Hangenberg Crisis equivalent deposits and associated conodont faunas including *Siphonodella* progenitors from late Devonian island arc settings (Indert Formation, Shine Jinst region, southern Mongolia). - Newsletters on Stratigraphy: 1-24; doi: 10.1127/nos/2023/0760.

CM Sue TURNER

The paper on the Birch Creek II fauna of Nevada is now published with vertebrate (thelodont, acanthodian, “shark” scales and other bits) and conodont evidence from this most important Ludlow, Pridoli to Lochkovian series of sections, investigated by Mike MURPHY. Carole BURROW and Sue, with Cemel and Yakut GÖNCÜGLO and Phil JANVIER have completed a paper on Lower Devonian fish remains from the Antalya region of Turkey. Other projects with Carole on Devonian fish and biostratigraphy, notably from Australia, and Pakistan, and the revision of gyracanthids taxonomy (Devonian-Carboniferous) continue.

Sue presented a talk on work done with and the life of the late ALAIN BLIECK, notably for UNESCO: IUGS projects at the special memorial for our colleague, on September 28th 2022 at the Société géologique du Nord, at USTL, Villeneuve d’Ascq.

Publications

BURROW, C. J., MURPHY, M. A. & TURNER, S. (2023). Late Silurian to earliest Devonian vertebrate biostratigraphy of the Birch Creek II section, Roberts Mountains, Nevada, U.S.A. – Paleobios: 32 pp. + Supplements.

TURNER, S. (2023). Our honoured colleagues, Drs Tiiu MÄRSS and Philippe JANVIER, commemorated at the 16th ISELV, Valencia, Spain: personal memories. - Spanish Journal of Palaeontology, **38**: 1-5; doi.org/10.7203/sjp.26505.

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

Activities during this period have mainly focused on the participation in the most relevant professional meetings (ICOS, IPC, SDS, STRATI 2023), as well as in the Spanish Paleontological Society meeting. Additionally, we have conducted several fieldwork campaigns, followed by sample analysis and preliminary data collection on lower and middle Famennian conodonts in the Spanish Pyrenees. We have also initiated a new research concerning Silurian/Devonian conodonts in outcrops in Andorra. Furthermore, we have presented the initial compilation of biostratigraphic and geophysical data pertaining to the Pragian/Emsian boundary in the Pyrenees at two professional meetings, with elaborated papers in the pipeline. Further details on these activities and additional information are provided below.

As in previous years, Nacho and Teresa have concentrated their efforts on Lower, Middle and Upper Devonian conodont biostratigraphy, Middle Devonian conodont biofacies, and the analysis of Lower and Middle Devonian microfacies in selected Pyrenean sections. In the fall of 2022 and throughout the spring-summer of 2023, as part of our on-going collaboration with Heiko HÜNEKE from the University of Greifswald, two notable activities have taken place: 1) Teresa has supervised an internship for one of Heiko's student, focusing on Middle Devonian microfacies and conodont biostratigraphy in a critical Pyrenean section; 2) Nacho has mentored another student during an internship devoted to the Pragian/Emsian boundary in neritic facies (Iberian Chains).

In early in 2023, Teresa submitted a proposal for a short stay in Montpellier, where she will continue her direct study on selected sections and intervals from the Montagne Noire in cooperation with Catherine GIRARD and Raimund FEIST. Recently, she received positive news from the Spanish Ministry, and she will spend three months (September-November) in Montpellier working closely with Catherine and

Raimund. Preliminary results were presented at IPC meeting held in Thailand.

We keep processing samples and analysing sequences from the Pyrenees and the Iberian Cordillera. This year our focus has been on Lochkovian, Emsian, Givetian, and Famennian sections. Specifically, we are supervising a new Ph.D. student, **Héctor BARRERA-LAHOZ**, from the University of Zaragoza, whose primary conodont research is focused on a diachronic stratigraphic unit spanning the F/F boundary in the Pyrenees. Preliminary results have been presented at the Spanish Paleontological Society meeting (October 2022, Cuenca) and STRATI 2023 (Lille), and another presentation is scheduled for the upcoming Spanish Paleontological Society meeting (October 2023, Valencia). Furthermore, we have submitted a paper discussing the taxonomic richness of the lower and middle Famennian conodonts from a Pyrenean section to the Spanish Journal of Paleontology.



Fig. 3. Field aspect of beds 104-113 (Famennian) in section Compte (Spanish Pyrenees).

As previously reported, we have started multidisciplinary studies on Devonian sections and outcrops in both the Spanish Central Pyrenees and the Iberian Chains. Last year, we focussed on sampling for palaeomagnetic and magnetic susceptibility in two selected Pyrenean sections (Isábena-1 and Baliera-6), which include the Pragian-Emsian transition. Preliminary results, in collaboration with Spanish colleagues from the GEOTransfer Research Group at the University of Zaragoza, have been presented at two meetings (STRATI

2023 and MagIber 2023). The samples “leftovers” will be prepared for geochemical analysis; with cooperation from colleagues at the National Research Centre (CSIC), Geochemical Lab in Granada.

Our long-term project involving the detailed analysis of Bohemian conodont faunas around the S/D interval, initiated in collaboration with Mike MURPHY and the late Peter CARLS, is progressing.

Our cooperation with paleobotanics, which began in the Lower Devonian strata of the Iberian Chains, continues to expand. We aim to augment the palaeontological characterization of Lower Devonian strata in the Iberian Chains by including the palynological record, extending this on-going project to Middle and Upper Devonian strata. New Upper Devonian records are currently in preparation and represent the first evidence for land plants in the Frasnian of the Iberian Chains. Preliminary results will be presented at the Spanish Paleontological Society Meeting (Valencia, October 2023).

We have also started to focus on the identification of “Events” in the Spanish Pyrenees and to study them from a multidisciplinary point of view.

Teresa continues her Middle and Upper Devonian joint project with Susana GARCÍA-LÓPEZ from the University of Oviedo, focusing on selected localities in the Cantabrian Mountains. She is currently concentrating on the Kačák Event in several Spanish sections.

Our collaboration with the late friend Xiuquin CHEN (Suzi) and our former Ph.D. student Jianfeng LU continues to yield results, mainly related to Pragian and Emsian outcrops in South China. These efforts mark the initial steeps in the envisaged long-term Chinese-Spanish cooperation.

In our on-going Spanish-Portuguese Devonian cooperation, we are finalizing a multidisciplinary paper dealing with an Eifelian quarry in Portugal. This collaboration has expanded to include the analysis of the

Silurian/Devonian boundary in two selected sections from Andorra (Figs. 1-2). Nacho’s Ph.D. student **Gonçalo SILVÉRIO** is conducting the conodont study, with Noel MOREIRA, Gonçalo’s co-supervisor, contributing to the stratigraphy and structural setting of the studied area. This study receives support from the Heritage Division of Andorra (Ministry of Culture) and by the Andorra Institute of Research and Innovation.



Fig. 1. Silurian/Devonian transition in section Arinsal 1 (Andorra).



Fig. 2. Detail of one of the Andorra *Scyphocrinites* beds.

In terms of heritage protection actions in Spain, we are actively involved in a project affecting Devonian outcrops in the Spanish Pyrenees. A company has proposed extending the current sky-resort near Cerler by connecting

two valleys. Given that this action necessitates the construction of a new road at high elevation (over 2.200 m), where Devonian rocks crop out, we were called upon to assess the impact of this road. Preliminary results confirm the presence of Pragian, Emsian, Givetian, and Frasnian rocks. In the initial phase, we recommended the preservation of these outcrops, and both the company and the government accepted our proposal. The road will be deviated to avoid affecting the outcrops, and we were able to collect a variety of Devonian microfossils, including conodonts. This year, as additional portions of the mountain will be affected, they have once again solicited our assistance, and a new fieldwork (and subsequent lab processing and report writing) is envisaged.

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, in collaboration with other Spanish colleagues (Miguel PARDO and Esperanza FERNÁNDEZ). This project entails large field-campaigns and mapping in rough areas. 2) The continuation of our long-term collaboration with the late 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 to publish comprehensive monographs on brachiopods from the Cantabrian Mountains. 4) The Ph.D. proposal, dealing with the Silurian-Devonian outcrops in Spain and Portugal (Centro-Iberian and South Portuguese Zones), co-supervised with Noel MOREIRA, was granted and, consequently, the doctoral student Gonçalo SIVÉRIO has started his Ph.D. under this cooperation; his extension to include Andorra outcrops is aforementioned. 5) A Ph.D. proposal focusing on upper Frasnian and lower and middle Famennian rocks, fossils (mainly conodonts) and geophysical and geochemical signals has been launched. The candidate, Héctor BARRERA-LAHÖZ, has already presented preliminary results and a paper has been submitted. 6) Thanks to the DAAD-WELTRISE program, two students from the

University of Greifswald (Elina SCHIEBACK and Nora PINGEL) spent eight weeks each under the guidance of Teresa and Nacho, respectively. They primarily focused on Lower (Nora) and Middle (Elina) Devonian stratigraphy and conodonts from Spain.

Publications

Papers

BARRERA-LAHÖZ, H., VALENZUELA-RÍOS, J. I. & LIAO, J.-C. (2023 submitted). Lower and middle Famennian conodonts of the CP section (Spanish Central Pyrenees): A taxonomic study. - Spanish Journal of Paleontology.

VALENZUELA-RÍOS, J. I. & LIAO, J.-C. (2023 in review). Biodiversity and Evolutionary phases of Lochkovian (Lower Devonian) Conodonts in the Pyrenees: A Comparative Study. - Marine Micropaleontology.

Abstracts

BARRERA-LAHÖZ, H., VALENZUELA-RÍOS, J. I. & LIAO, J.-C. (2022). Nuevos datos sobre el Devónico Medio de la Depresión Axial del Río Cámaras (Cordillera Ibérica). - In: BLANCO et al. (eds.), Libro de Resúmenes de las XXXVII Jornadas de la Sociedad Española de Paleontología y V Congreso Ibérico de Paleontología; Palaentological Publications, 2: 33.

BARRERA-LAHÖZ, H., VALENZUELA-RÍOS, J. I. & LIAO, J.-C. (2023). La Mena Formation in the Compte Section (Famennian, Upper Devonian, Spanish Pyrenees). - In: 4th International Congress on Stratigraphy, STRATI 2023, Book of Abstracts: 268-269.

LIAO, J.-C., BARRERA-LAHÖZ, H. & VALENZUELA-RÍOS, J. I. (2022): Eifelian and Givetian (Middle Devonian) conodonts in the Iberian Chains. From Gondwana to Laurasia. – In: The 6th International Palaeontological Congress, Abstract Book: 111.

LIAO, J.-C., GIRARD, C., NESME, F., VALENZUELA-RÍOS, J. I. & FEIST, R. (2022). Advances in the Middle and Upper Devonian Stratotype section at Col du Puech de la Suque (Montagne Noire, France). – In: The 6th International Palaeontological Congress, Abstract Book: 99.

LIAO, J.-C. & VALENZUELA-RÍOS, J. I. (2022). Colaboración público-privada en beneficio de la Paleontología: El caso del Devónico Medio y

- Superior del Collado de Basibé. - In: BLANCO et al. (eds.), Libro de Resúmnenes de las XXXVII Jornadas de la Sociedad Española de Paleontología y V Congreso Ibérico de Paleontología; Palaentological Publications, 2: 99.
- LIAO, J.-C. & VALENZUELA-RÍOS, J. I. (2023). Biostratigraphical correlation and palaeogeographic relations of the Middle-Upper Devonian carbonate successions in the Spanish Central Pyrenees. - In: 4th International Congress on Stratigraphy, STRATI 2023, Book of Abstracts: 279-280.

OLIVA-URCIA, B., CASAS-SAINZ, A., ROMÁN-BERDIEL, T., VALENZUELA-RÍOS, J. I. & LIAO, J.-C. (2023). Correlación de secciones deformadas del Devónico Inferior mediante la susceptibilidad magnética en los Pirineos Centrales (valles de Isábena y Baliera). - In: SANT'OVAIA, H. et al. (eds.), MagIber, Livro de Resumos: 90-91

SILVÉRIO, G., LIAO, J.-C., VALENZUELA-RÍOS, J. I., MOREIRA, N. & MACHADO, G. (2022). A first approach on the palaeoenvironmental analysis on the Pedreira da Engenharia Formation (Middle Devonian) using microfossils assemblages. - In: BLANCO et al. (eds.) Libro de Resúmnenes de las XXXVII Jornadas de la Sociedad Española de Paleontología y V Congreso Ibérico de Paleontología; Palaentological Publications, 2: 182.

VALENZUELA-RÍOS, J. I. & LIAO, J.-C. (2022). La sección Se 5 (Pirineo Central Español) y su relevancia para la evaluación del límite inferior del Lochkoviense medio (Devónico Inferior). - In: BLANCO et al. (eds.) Libro de Resúmnenes de las XXXVII Jornadas de la Sociedad Española de Paleontología y V Congreso Ibérico de Paleontología; Palaentological Publications, 2: 186.

VALENZUELA-RÍOS, J. I. & LIAO, J.-C. (2022). Lower-middle Lochkovian (Lower Devonian) conodont Boundary in the Spanish Pyrenees. From Gondwana to Laurasia. - In: The 6th International Palaeontological Congress, Abstract Book: 96.

VALENZUELA-RÍOS, J. I., OLIVA-URCIA, B., CASAS, A. & LIAO, J.-C. (2023). The Pragian/Emsian boundary in the Huesca Province (Lower Devonian, Spanish Pyrenees): Biostratigraphic and magnetic data. - In: 4th International

Congress on Stratigraphy, STRATI 2023, Book of Abstracts: 289-290.

CM Charles VER STRAETEN

Major work over the last year included finishing the three-volume-set *Devonian of New York* (<https://www.priweb.org/devonian-ny>), and my involvement with the 11 day New York SDS meeting in late July to early August. Happily, the release of *Devonian of New York* coincided with the SDS banquet at the Paleontological Research Institution on August 2nd.

Devonian terrestrial research in the Catskill Mountains region of eastern New York continues to be my major research thrust. These lower Givetian to Frasnian strata remain one of the frontiers of New York sedimentary rock successions. Extensive forest and thin soil cover of the estimated 2.4 km-thick strata have always blocked development of a well-grounded stratigraphy. Another aspect of this work is to better understand and recognize facies across marine-terrestrial transitions.

However, Daniel DOCTOR of the U.S. Geological Survey has introduced me to rotatable 3d lidar imagery. This has revolutionized working in the Catskills terrestrial section. The lidar passes through the forest and thin soil cover on the mountain sides, showing the layering of the bedrock. With this, strata can be correlated mountain to mountain, in some cases, over long distances. The combination of this technology and field checking appears to permit establishing an actual, well-grounded stratigraphy in the coming years. There will be limits, however – I have no background in GIS technology. I will do my best.

One of the other main issues in the terrestrial strata is a scarcity of time-relevant data, such as: 1) biostratigraphy (e.g., palynology, microvertebrate analyses); 2) terrestrial sequence stratigraphy (difficult in highly covered strata, and poorly linked to marine sequences on mid to upper levels of

alluvial plains/slopes); and 3) radiometric dating. The first would need partnerships, and a better sense of viable sampling on my part; the second may be assisted by the 3d lidar analyses, at least partway up through the thick Catskill succession; and for the third issue, it appears that I'm finally able to recognize altered airfall tephras/ashes/K-bentonites in the Devonian terrestrial strata, something I've been successful at in the Devonian marine succession. I plan to send initial samples in coming months to Mark SCHMITZ at Boise State University, Idaho, for U-Pb geochronologic dating.

Among other projects, Alex BARTHOLOMEW and I have been working to extend understanding and correlations of marine Middle Devonian Hamilton Group strata in the greatly thickened strata in eastern New York. One step forward is the recognition of faunal and lithologic data indicating that lowest terrestrial strata in easternmost outcrops are correlative with upper Marcellus subgroup black shales in western New York, in shallowing upper strata of the second of three 4th order sequences of Devonian Sequence Eif-Giv/Ie.

Publications

For the numerous contributions to the Devonian of New York volumes, see the Devonian Publications section.

Abstracts

BARTHOLOMEW, A. J. & VER STRAETEN, C. A. (2023). Marine strata of the Middle and Upper Hamilton Group (Middle Devonian, lower Givetian), eastern outcrop belt in New York State. - In: OVER, D. J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks, Geneseo, New York, 27 July – 06 August 2023, Program and Abstracts: 17-18.

DA SILVA, A.-C., BRETT, C. E., BARTHOLOMEW, A., VER STRAETEN, C., HILGEN, F. & DEKKERS, M. J. (2023). The Kingston record, New York State, U.S.A. – a window to the Devonian paleoclimate and to the duration of the Emsian. – In: OVER, D. J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks, Geneseo,

New York, 27 July – 06 August 2023, Program and Abstracts: 31.

MADILL, E., TERRY, D. O. & VER STRAETEN, C. A. (2023). Paleoclimate during deposition of the Late Devonian greater Twilight Park Conglomerate, southeastern New York. - Geological Society of America, Abstracts with Programs, 55.

TERRY, D. O. & VER STRAETEN, C. A. (2023). Differentiating marine and terrestrial deposits in transitional depositional environments of the Catskill Delta Complex: A quick and dirty guide. - Geological Society of America, Abstracts with Programs, 55.

VER STRAETEN, C. A. (2023a). The Devonian terrestrial system in New York. - In: OVER, D. J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks, Geneseo, New York, 27 July – 06 August 2023, Program and Abstracts: 72-73.

VER STRAETEN, C. A. (2023b). The Devonian in New York and North America/Laurentia. - In: OVER, D. J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652 Reading geologic time in Paleozoic sedimentary rocks, Geneseo, New York, 27 July – 06 August 2023, Program and Abstracts: 74-75.

VER STRAETEN, C. A. (2023c). Investigating the Acadian-Neoacadian orogenies: Multiple foreland lessons. - Geological Society of America, Abstracts with Programs, 55.

VER STRAETEN, C. A. (2023d). Devonian of New York: An extensive overview, and guide to future research. - Geological Society of America, Abstracts with Programs, 55.

VER STRAETEN, C. A. & DOCTOR, D. (2023). Correlating Devonian terrestrial strata in the Appalachian Basin: Challenges and issues. Geological Society of America, Abstracts with Programs, 55.

CM Stanislava VODRÁŽKOVÁ

The duration of our project on Silurian - Carboniferous microbial sediments has been prolonged to 2023 and we are currently preparing publications on Carboniferous

lacustrine stromatolites from the Czech Republic and various grains of supposedly microbial origin from the Prague Basin, Brunovistulicum, and Gotland. Together with Thomas SUTTNER as the leading author, we are working on the Middle Devonian conodonts from Graz and Carnic Alps.

CM Jinzhuang XUE

My group is from Peking University, China, and working on Devonian fossil plants and related strata. I am very glad to have this opportunity to share our news with colleagues working on the Devonian.

A new project entitled “*The colonization of land by plants and its effects on Earth’s environments and resources*”, supported by the National Key R&D Program of China, stated in November 2022. This multidisciplinary project includes the following four parts: 1) stepwise evolution of Silurian-Carboniferous land plants (led by Jinzhuang XUE); 2) deposition of non-marine Silurian-Carboniferous in China (led by Prof Yi WANG from Nanjing Institute of Geology and Palaeontology); 3) the relationships between plant evolution and the formation of bauxite and coals (led by Prof Jing LU from the China University of Mining and Technology (Beijing)); 4) effects of early plant evolution on continental weathering and Earth System (led by Prof. Bing SHEN from Peking University). The participants include more than 70 researchers and students from different universities and institutes around China. In the coming years, it is expected that more studies will focus on the evolution of Devonian plants and their interplay with the Earth System.

In 2023, we performed many weeks of fieldwork in China and collected a lot of plant fossils from Yunnan, Guizhou, Ningxia, and other regions. Besides the plant fossils, we are also interested in studying the “non-marine” Devonian strata, based on sedimentology, ichnology, and other approaches.

In recent years, Ph.D. student **Jiashu WANG** has been working on the Early Devonian

deposits of Qujing, Yunnan, which include the Xiaishancun, Xitun, Guijiatun, and Xujiachong formations in ascending order; they have been traditionally considered non-marine in origin. The exact position of the Silurian–Devonian Boundary (SDB) in the Qujing sequence is difficult to determine, but many studies put the SDB at the base of the Xiaishancun Formation - this view is supported by Dr Feng LIU (personal communications) and his group at Nanjing, who recently re-investigated palynological samples and obtained some preliminarily results. According to Jiashu’s study (finished manuscript), the earliest Devonian Xiaishancun Formation is interpreted as mainly representing deposits of hyperpycnal subaqueous deltas, where diverse benthic communities developed as evidenced by over 36 ichnospecies. The Xiaishancun Fm. represents one of the rare cases of Paleozoic hyperpycnal depositional systems, and records a rapid increase of terrestrial input during the earliest Devonian, after a certain period of starvation as recorded by the underlying black shale of the Yulongsi Formation. Such an increase in terrestrial input was probably related with the Silurian–Devonian transition events. In addition, Jiashu WANG et al. (2022) described a new eurypterid, *Malongia mirabilis*, from the Xiaishancun Fm., a taxon representing the only report of the family Dolichopteridae outside Laurussia.

XUE et al. (2023b) studied the Guijiatun Formation, which contains diverse and abundant redbed calcareous paleosols, most being classified as calcisols. It is of particular interest that the soil inorganic carbon (SIC) contents stored as Ca-Mg carbonates in the Guijiatun paleosols have been estimated, and the value is comparable to the highest levels of present-day dryland ecosystems. We argue that the Early Devonian dryland floras might have been prominent, controlling the retention of both mobile elements (Ca and Mg) and fine-grained sediment on land, and mantling and protecting buried soil carbon against erosion.

Other studies in 2022 and 2023 were mainly focusing on the evolution of early vascular plants, including zosterophyllopsids (YANG et al., 2022; the first author received a master degree in 2022), ferns (BAI et al., 2022; the first author received a Ph.D. degree in 2021), sphenopsids (HUANG et al., 2022a), seed plants (Deming WANG et al., 2022), and others.

Jinzhuang XUE also participated in the quantitative analyses of Silurian and Devonian plants led by Eliott CAPEL, Thomas SERVAIS, and Borja CASCALES-MIÑANA at Lille University, and together we finished two papers (CAPEL et al., 2022, 2023). CAPEL et al. (2022) demonstrated clear increases of plant richness in the Pragian (Early Devonian) and Givetian (Middle Devonian), which may be related to the early expansion of the tracheophyte clades and the initial diversification of forested ecosystems, respectively. CAPEL et al. (2023) showed that observed raw diversity patterns at both species and genus rank of early land plants are significantly correlated with fluctuations of sedimentary rock volume, especially of nonmarine fossiliferous deposits. The latter study cast doubts the evolutionary patterns we read from the fossil record.

Publications

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YANG, S., HUANG, P., LIU, L., WANG, J. S., ZHANG, J. D. & XUE, J. Z. (2022). A new zosterophyllopsid plant with encrusted microconchids from Lower Devonian Guijiatun Formation of Qujing, Yunnan Province. - *Acta Scientiarum Naturalium Universitatis Pekinensis*, **58**: 861-874 (in Chinese).

CM James J. ZAMBITO IV

Over the past year my Devonian research has continued to focus on understanding how the evolution of forests changed the global carbon cycle and the organic matter composition of marine black shale. Various core and outcrops of Middle and Upper Devonian strata from the North American Appalachian, Illinois, and Michigan Basins have been studied utilizing an integrated litho-, chemo-, bio-, and sequence stratigraphic approach to constrain regional black shale compositional changes within a high-resolution stratigraphic framework; the ultimate goal of this research is to use $\delta^{13}\text{C}_{\text{TOC}}$ chemostratigraphy to recognize Devonian global events within condensed black shale successions. This work has been funded by the American Chemical Society Petroleum Research Fund (#60525-UR2) and the Keck Geology Consortium.

This past year also saw the culmination of collaborative work with Carlton BRETT, Gordon BAIRD, and Alexander BARTHOLOMEW on revising Middle Devonian Stratigraphy in New York State. This work was highlighted at the SDS Meeting in Geneseo, New York, and recently published by the Paleontological Research Institution in *Bulletins of American Paleontology*.

Publications

For the contributions to the Devonian of New York volumes see the Devonian Publications section.

Abstracts

BRETT, C. E., BAIRD, G. C., BARTHOLOMEW, A. J., IVANY, L. C. & ZAMBITO IV, J. J. (2023). Ecological-evolutionary patterns and processes in the Devonian of the Appalachian Basin. – In: OVER, D.J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652, Geneseo, New York, Reading geologic time in Paleozoic sedimentary rocks Geneseo, New York, 27 July – 06 August 2023 Program and Abstracts: 23-24.

ZAMBITO IV, J. J., WELDON, A. C., FARBARIK, O. B., BOLIN, D. L. & McLAUGHLIN, P. I. (2023). Using

$\delta^{13}\text{C}_{\text{TOC}}$ chemostratigraphy to recognize Devonian global events in the New Albany Shale (Illinois Basin, U.S.A.) – In: OVER, D. J. (ed.), Subcommission on Devonian Stratigraphy and IGCP 652, Geneseo, New York, Reading geologic time in Paleozoic sedimentary rocks Geneseo, New York, 27 July – 06 August 2023 Program and Abstracts: 82-83.

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CM Ahmed ZEGHARI

Currently, research concentrates on the Lower Devonian of the southern Tindouf Basin (my PhD project), with a focus on the stratigraphy, sedimentology, microbial structures, iron ore deposits, brachiopod and other faunas (dacyroconarids, trilobites, bivalves). This includes cooperation with Thomas BECKER and David DEVLEESCHOUWER at Münster University and Uli JANSEN (for the brachiopods) and Eberhard SCHINDLER (for tentaculitoids) from the Senckenberg Institute in Frankfurt. A first manuscript on the microbially-influenced siliciclastics of the Gara Djebilet area, with Prof. Abdelkader OUALI MEHADJI from Oran University and Thomas, is close to submission. Subsequent work will try to improve the regional biostratigraphy and extent the work to higher strata. In addition, there are new collections of goniatites, brachiopods, and trilobites from the Ougarta Range (Eifelian - Givetian), which are studied in collaboration with my friend and Ph.D. colleague Ahmed Yacine KHALDI from Oran 2 University