

ANNUAL REPORT 2022

PALAEONTOLOGY GROUP

WWU Münster

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

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

Due to the special financial support by SDS, we had a focus on Pragian-Emsian successions, notably in the sections Jebel ben Arab, Bab-al-Ari (Fig. 1), and Bou Trou, all in the wider Azrou region. Each succession differs considerably, reflecting variable tectonic settings (parautochthonous or allochthonous Klippen within the Variscan flysch). The three sections contain pelagic flaserlimestone/griotte facies but, as we learned in the Anti-Atlas (see ABOUSSALAM et al. 2015), this does not mean that we can necessarily expect polygnathid faunas. In any case, the Meseta and Anti-Atlas Pragian-Emsian sequences will be important since any revised basal Emsian GSSP proposal will have to include documentation how it

can be correlated internationally. As our Meseta research progresses, we realize that there are further interesting sections that we have not yet touched.



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

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

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

await their publication under the lead of Claudia DOJEN (Klagenfurt).

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

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



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

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

Our research focus on Devonian reef developments and extinctions continued in the Moroccan Meseta, e.g. on reefal debris in the Azrou/Mrirt regions, and with respect to the Ph.D. project of Stephan EICHHOLT (see below). Sarah's conodont data enable a joint metastudy on the timing of reef growth and extinctions in southern latitudes, planned for a high-ranked journal. Our cooperation project with the Lhoist Rheinkalk GmbH in the Hönne Valley (northern Rhenish Massif) is coming to an end, as manifested by the extensive two new papers on the initial (LÖW et al.

2022) and final reef phases (STICHLING et al. 2022). The first yielded an unusual new discosorid nautiloid, which was described and named as *Binoleniceras* n. gen. by AFHÜPPE & BECKER (2022). A review of all Givetian nautiloid reports from the Rhenish Massif revealed how little is known in reality and how much revision should be done. But by whom? For the extinction of the youngest German reef complex around the Velbert Anticline, there are many unpublished data from the northeast (samples have been picked over the last five years), the new work by Felix (see below) at Schlupkothen, and data from youngest coral debris flow beds of the Wiedenhof section (Fig. 3), currently the most western Frasnian outcrop before the Rheingraben that is filled by thick Tertiary and Quaternary sediments.



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

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

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

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

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

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

CM Zhor Sarah ABOUSSALAM

Sarah has been very busy with preparations for the third Meseta volume, which includes conodont identifications (excluding Famennian faunas), SEM photography, plate compilations, and carbonate microfacies analyses. Biostratigraphic dating was sometimes complicated by complex reworking of Eifelian to Frasnian faunas in lower/middle Famennian flaserlimestone/breccia successions (Fig. 4). Strongly mixed assemblages may alternate with mostly Givetian-Frasnian associations, which recycling may not become apparent if only small spot samples were taken. As previously known from

the Lower Devonian of the Anti-Atlas, floods of *Belodella* (*Belodella* Biofacies) may occur in Middle Devonian limestones that in the field appear to belong to a pelagic setting. There are plans to further develop conodont biofacies models in future. As a first step, two new specimen-poor biofacies types (with simple cones, such as *Neopanderodus* and *Dvorakia*, or *Bipennatus*) were recognized in lower Givetian biostrome facies of the Hönne Valley (BECKER & ABOUSSALAM in LÖW et al. 2022).

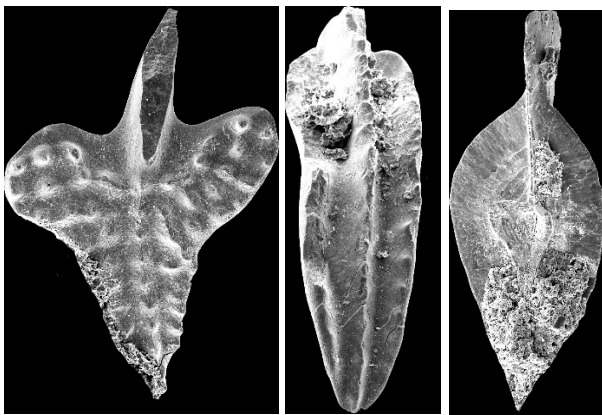


Fig. 4. Mixed Givetian and Frasnian conodonts from a Famennian breccia bed of the Dechra-Aït-Abdallah region, west of Mrirt, eastern part of Western Meseta, Morocco.

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

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

Ph.D. students

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

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

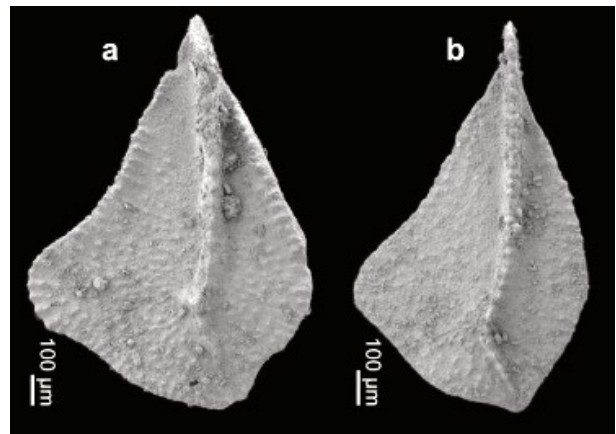


Fig. 5. Co-occurring, stratigraphically youngest *Palmatolepis jamieae jamieae* (a) and *Pa. jamieae savagei* (b) from the upper Frasnian *bogartensis* Zone (FZ 13a) at Beringhauser Tunnel.

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

on upper Frasnian conodont biodiversity in the Rhenish Massif.

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

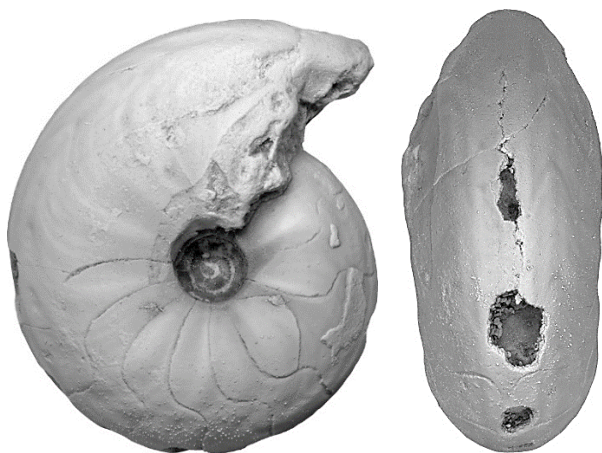


Fig. 6. Well-preserved, new *Aulaternoceras* from the middle Frasnian of Oued Mzerreb in the eastern Dra-Valley, southern Morocco.

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

M.Sc. Students

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

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

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



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

B.Sc. students

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

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

Publications

Peer-reviewed papers (mostly open access)

- AFHÜPPE, L. & BECKER, R. T. (2022 online). A new discosorid and some other nautiloids from the Givetian of the Rhenish Massif, Germany. - *Palaeobiodiversity and Palaeoenvironments*, 15 pp.; doi.org/10.1007/s12549-022-00541-3.
- GROOS-UFFENORDE, H., SCHINDLER, E., BECKER, R. T., DOJEN, C., BROCKE, R. & JANSEN, U. (2022, online): Late Early Devonian ostracodes from the Torkoz area (SW Morocco) and the Emsian/Eifelian boundary. - *Paläontologische Zeitschrift*, 59 pp.; doi.org/10.1007/s12542-022-00603-z.
- HARTENFELS, S., BECKER, R. T., HERBIG, H.-G., QIE, W., KUMPAN, T., DE VLEESCHOUWER, D., WEYER, D. & KALVODA, J. (2022 online). The Devonian-Carboniferous transition at Borkewehr near Wocklum (northern Rhenish Massif, Germany) – a potential GSSP section. - *Palaeobiodiversity and Palaeoenvironments*, 67 pp.; doi.org/10.1007/s12549-022-00531-5.
- HELLING, S. & BECKER, R. T. (2022 online). Two new species of *Gondwanaspis* (Trilobita, Odontopleurida) from the Givetian-Frasnian transition of the northern Rhenish Massif (Germany). - *Palaeobiodiversity and Palaeoenvironments*, 13 pp.; doi.org/10.1007/s12549-022-00525-3.
- LÖW, M., SÖTE, T., BECKER, R. T., STICHLING, S., MAY, A., ABOUSSALAM, Z. S. & ZOPPE, S. F. (2022 online). The initial phase of the Hönne Valley Reef at Binolen (northern Rhenish Massif, Middle Devonian). – *Palaeobiodiversity and Palaeoenvironments*, 40 pp.; doi.org/10.1007/s12549-022-00540-4.
- SAUPE, F. & BECKER, R. T. (2022 online). Refined conodont stratigraphy at Martenberg (Rhenish Massif, Germany) as base for a formal middle/upper Frasnian substage boundary. - *Palaeobiodiversity and Palaeoenvironments*, 51 pp.; doi.org/1007/s12549-022-00537-z.
- SÖTE, T. & BECKER, R. T. (2022a, in press). Upper Frasnian ammonoids (Tornoceratidae) from Büdesheim (Eifel Mountains, Rhenish Massif, Germany). – *Palaeontographica*, Abt. A.
- SÖTE, T. & BECKER, R. T. (2022b, in prep.). Middle/upper Frasnian tornoceratids (Goniatitida) of Oued Mzerreb (Dra Valley, Morocco). – *Neues Jahrbuch für Geologie und Paläontologie*.

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

TALIH, A., ABOUSSALAM, Z. S., BECKER, R. T., SAADI, M. & BENMLIH, A. (2022, in press). Stratigraphy and tectono-sedimentary processes of allochthonous Devonian deposits of the Tisdafine Basin, Eastern Anti-Atlas, Morocco. - Bulletin de l'Institut Scientifique, **44**.

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

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

Abstracts

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

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

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

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

Devonian thesis

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