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PALAEONTOLOGY GROUP
WWU Münster

Ralph Thomas BECKER

The first half year after our last report was devoted to the first issue of a planned series of monographs on the Devonian and basal Carboniferous of the Moroccan Meseta (see Devonian publications), published under the auspice of the Hassan II Acdemy of Science and Technology of Morocco. It combines results of work in the last ca. 10 years in the Meseta, in close cooperation with our good friend (and Moroccan CM) Ahmed EL HASSANI. We are aware that the academy journal does no rank very high internationally, but we want to make sure that our data are easily and widely available to the community of Moroccan geoscientists. And it is also a decent way to honor our long-term cooperation and the support from Moroccan science authorities over many years. A second joint issue, mostly with Sarah and Ahmed, is planned for the spring of 2021 and will cover central to more southernly Meseta regions (Benahmed region, Rehamna (Fig. 1), Jebilet, Skoura region).

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

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

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

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

In autumn 2019, ZHONG Pu came over from Beijing in order to continue joint studies on Chinese Devonian ammonoids. Our cooperation focuses currently on new gonioclymeniid material from

Xinjiang and on a long-neglected *Manticoceras* fauna from Hunan, brought to Münster many years ago by MA Xueping. The latter investigations fit well a new project submitted to the DFG with the main aim to revise fundamentally the upper Frasnian Gephuroceratidae of Germany, Morocco, and Australia, using modern morphometrics and statistical approaches. We hope that the application goes through this time.

The cooperation with Polish Devonian geochemical workers continued and resulted in the paper by PISARZOWSKA et al. (2020) on the Middlesex Event at Padberg, eastern Sauerland. The stratigraphic chapter by Sarah and Thomas was heavily shortened after the reviews but the remaining part includes a very important point: the major positive excursion did not begin in the *punctata* Zone, as suggested by the past wide use of the term "*punctata* Event", it started everywhere slightly earlier, at the level of oldest *Ancyrodella nodosa* (= *gigas* M1), which does occur in the black Middlesex Shale of eastern North America. The truth always lies in the fine details. A close look at the conodont data from Nevada suggests that the Alamo Impact could well correlate with the Middlesex Event. This may be a coincidence – or not. It is planned to publish all the details (biostratigraphy, geochemistry) that did not make it into the first paper in a second joint contribution. The conodont workers should be reminded that Padberg is the type locality of several important species, which precise ranges have never been published in a bed-by-bed survey.

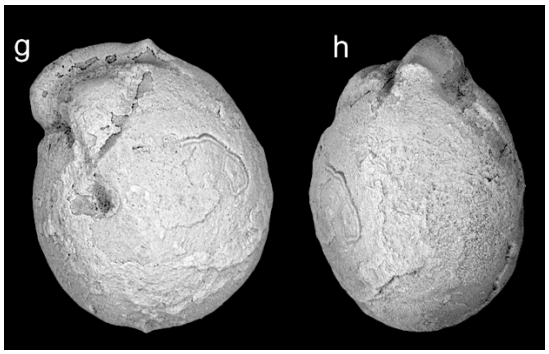

Fig. 2. The irregularly constricted and paedomorphic goniatite *Kenseyoceras rostratum* from the top-Famennian at Borkewehr.

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

Zhor Sarah ABOUSSALAM

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

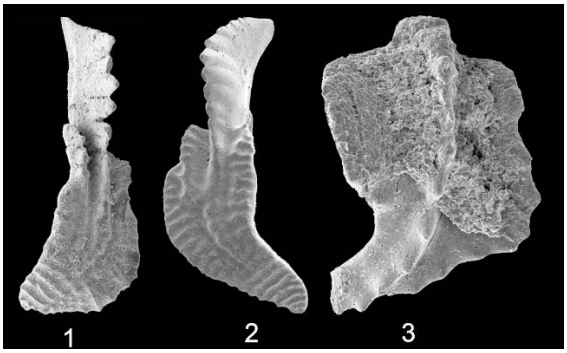

Fig. 3. Eifelian and Givetian conodonts from Immouzer-du-Kandar (Middle Atlas basement), with new records of Chinese taxa for Morocco, such as the irregularly ornamented *Linguipolygnathus qinjiaensis* (1-2) and the robust *L. oviformis* (3); ABOUSSALAM et al. (2020, fig. 17).

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

from around the Hofermühle Reef (Velbert Anticline, NW Rhenish Massif).

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

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

Stephan HELLING

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

Research assistants/Ph.D. students

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

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

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

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

Master students

Lukas AFHÜPPE finished his study of Givetian Oncoceratida and Discosorida from the Tafilalt (southern Morocco). In the end, he struggled hard because both groups have hardly been dealt with in the last decades. The reasons are multifold: the complex research history did not lead to clear taxonomic concepts, not even of higher systematic categories (e.g., the unequivocal distinction of the orders), the often poor and outdated descriptions of

many genera and species, a high variability of shell form, distinction of external and internal (siphuncle) shell features, and the lack of a morphometric approach by previous authors. He will stay for some more time at the Münster institute, which will give him time to write manuscripts.

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

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

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

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

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

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

B.Sc. Students

Kevin DUDA re-studied the upper part of the lower cliff of the Beringhauser Tunnel section in the eastern Sauerland, from where BUGGISCH & JOACHIMSKI (2006) had reported a positive carbon isotope excursion in the higher "*falsiovalis* Zone". His task was to document (with the help of Sarah) the detailed conodont stratigraphy, to study the local microfacies of proximal reef debris limestones, and to find the carbon isotope signal. We expected to find the Middlesex Event, at documented at Padberg (see above; PISARZOWSKA et al. 2020). However, this assumption proved to be

wrong. A manuscript is planned, which will have to incorporate subsequent samples taken in order to add precision to conodont ages and to the isotope curve. Tomas KUMPAN declared his interest to work on the elemental geochemistry of the section.

Alexander KLEMENT investigated for his B.Sc. project a series of sections at the top of the Schlupkothen Quarry, which lies at the southeastern end of the Velbert Anticline in the NW Rhenish Massif. The quarry exploited formerly a thick Frasnian reef succession and is now filled by a lake. It gave the name to the strongly microbial Schlupkothen Facies and Member of the Wülfrath Reef/Formation. Fortunately, the reef extinction interval is preserved at the southern rim of the quarry and safe as part of a recreation area. And the Upper Kellwasser Event and Frasnian/Famennian boundary, with highly intriguing sedimentological details, could be precisely located at a single spot in the woods. After additional samples have been processed, a paper shall be written for an international journal.

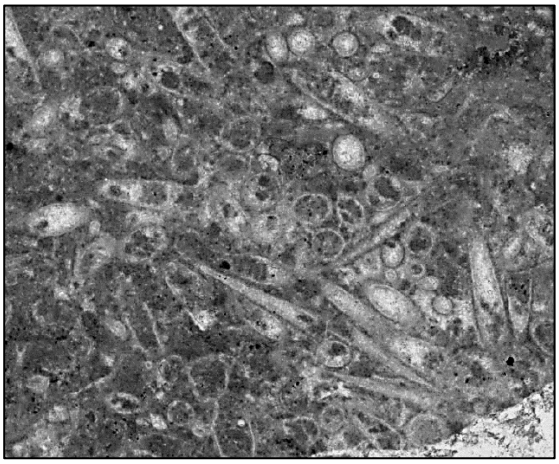

Fig. 5. Upper Kellwasser Event developed as dark-grey homoctenid packstone at Schlupkothen (SE Velbert Anticline, NW Rhenish Massif).

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

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

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Regular Publications

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

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B.Sc./M.Sc. Thesis

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

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

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

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

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

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