Conodonta, Trilobita, and Anthozoa near the Late Frasnian Upper Kellwasser Event of the Geipel Quarry section in Schleiz, Thuringian Mountains (Germany)

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With 2 figures and 1 plate

**Abstract**

New recoveries of Trilobita, Anthozoa and Conodonta from the linguiformis Zone close to the Frasnian-Famennian boundary and immediately preceding the Upper Kellwasser Event level at Schleiz (Thuringia) are investigated. The trilobites species are Harpes neogracilis Richter & Richter, 1924, Palpebralia cf. brecciae (Richter, 1913) and Acuticryphops acuticeps (Kayser, 1889), the latter is represented by several morphs with different numbers of eye-lenses; the trend to eye-reduction is discussed. The Rugosa fauna that was nearly unknown from the psychrospheric facies worldwide, comprise six taxa of the Cyathaxoniina. The rich conodont faunas permit tracing the exact boundary between the top of the Late Palmatolepis rhenana Zone and the Palmatolepis linguiformis Zone.

**Key words:** Late Frasnian, conodonts, trilobites, corals, biostratigraphy, Thuringian Mountains.

**Zusammenfassung**


**Schlüsselwörter:** Late Frasnium, Conodonta, Trilobita, Anthozoa Rugosa, Biostratigraphie, Thüringer Schiefergebirge.

**Introduction**

Since the first investigations at the end of the 18th century (Walch 1769), several sections of historical importance for the stratigraphical exploration in the Thuringian Slate Mountains of course have disappeared. Even today it might be difficult sometimes to preserve such outcrops as geological monuments under the law of protected nature reservations. Among Upper Devonian sequences deplorably lost at the northwestern flank of the Berga Anticline, there are to mention the exposures of the “Planschwitz” beds near Kirschkau (Geinitz 1853), the former Eulenburg Quarry (Müller 1956) and the outcrop of Alte Heerstraße (Brügge 1973), both near Ötersdorf, and now in part also the former Geipel Quarry in Schleiz (Frasnian-Famennian boundary of Müller 1956 still accessible, Wocklu-meria “Stufe” of Weyer 1981 at the entrance passage vanished). Therefore, a perhaps final fossil collecting was organized in 1995, with special reference to the once locally famous macrofauna (ammonites, trilobites, but now including also corals), all controlled by rich conodont communities.

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Received March 2003, accepted June 2003
Geipel Quarry section in the town of Schleiz

The Geipel Quarry Locality was first mentioned in 1915 by Ernst Zimmermann (1860-1944), renowned geologist with the Prussian Geological Survey in Berlin. He considered the Upper Devonian sequence exposed in the quarry as one of the very few suitable reference sections for the region along the northwestern flank of the Berga Anticline in the Eastern Thuringian Slate Mountains, editing the special geological map (scale 1:25000) of sheet Schleiz (Zimmermann 1915: 39, with record of Late Frasnian ammonoids). The quarry is named after the owner, a well-known businessman in Schleiz. In those days the quarry was situated just outside the western city gate; since then the quarry has became part of Schleiz and was abandoned prior to 1945. Some landscaping took place on the quarry after construction of a private house.

Schindewolf (1921: 172) actualized the local Frasnian ammonoid faunal list, based on own collections, rendered his trilobite material to the Richters (Richter & Richter 1926: 285), and later initiated the dissertation of Müller (1956), which includes a refined lithostratigraphy (Fig. 1) and a richer macrofaunal approach just before the start of conodont micropalaeontology (Helms 1961, then Schülke 1995). The section of Müller (1956) was also used by Blumenstengel et al. (1963: 29), Schlegel & Wiefel (1998: 273) and Bartzsch et al. (2002: 310); the actual outcrop became more and more incomplete under debris cover.

Fig. 1. Lithostratigraphy of the extremely condensed Frasnian-Famennian boundary beds (cephalopod limestone facies) in the abandoned Geipel Quarry in Schleiz (southern wall), compiled after Müller (1956: bed 1–5), Schülke (1995: bed 1*–12*) and Weyer (field work 1995: bed 4A**–C**). After Bartzsch et al. (2002: 310, fig. 3, with some modifications).
New collections of Weyer (in 1995) focused on corals. Ammonoids (*Crickites, Beloceras, Tornoceratids*) were rendered to Prof. Dr. R. T. Becker (Münster). The fauna is deposited in the Museum of Natural History (Palaeontology) of Humboldt University, Berlin (Anthozoa, Trilobita — numbers MB.) and in the collections of the Palaeontological Institute, University Claude Bernard, Lyon (Conodonta — numbers UL FGW...).

**Conodonts**

It is well established that in Frasnian/Famennian boundary sections of Rhenohercynian Avalonia (such as Martenberg, Steinbruch Schmidt, Sesacker, Benner Quarry near Bicken, and Burg Berg in the Rhenish Slate Mountains) the latest Frasnian *linguiformis* Zone starts with its index form, *Palmatolepis linguiformis* Müller, 1956 not far below the base of the Upper Kellwasser Horizon (Ziegler & Sandberg 1990). The relative abundance of *Palmatolepis linguiformis* in these localities on the Laurussian epicontinental margin seems to be related to the transgressive pulse that preceded the Upper Kellwasser Event (Racki et al. 2002).

In contrast, *Palmatolepis linguiformis* is mostly absent in North Gondwana derived terranes and in particular in the Frasnian/Famennian boundary stratotype area at Coumiac, Southern France (House et al. 2000). However it has recently been established in the Carnic Alps (Pramosio A section; Spalletta & Perri 1998) and in the Canning Basin of NW Australia (Klapper 1995), both related to the Northern Gondwana margin. Here we document the presence of *Palmatolepis linguiformis* in another terrane that derived from North Gondwana, the Saxothuringian unit that was part of the Armorican plate-assemblage (Franke 1999, Linnemann & Heuse 2000: fig. 1).

Records of *Palmatolepis linguiformis* Müller, 1956 from the Thuringian Mountains go back to 1963 but only appear in generalized faunal lists, without precise data concerning locality and horizon. The first note of Helms (1961: 40) even remained unpublished, although it was well known to local stratigraphers. Helms later (1963: fig. 2/12) provided an illustration of *Palmatolepis (Manticoles)* *linguiformis* from the Berga Anticline and (in Blumenstengel et al. 1963: 32, fig. 2/2) mentioned the species as an index fossil for the middle parts of the “Upper rhenana Zone” (sensu Ziegler 1962: 23); this chart was copied by Blumenstengel (in Steinbach 1974: fig. 33) and was cited by Pfeiffer (1967: tab. 3) and Wiel (1976: 549). Schülke (1995: 16, fig. 12) indicated the presence of the *linguiformis* Zone in a revised section of the Geipel Quarry in Schleiz (beds 4–5), but without naming the species itself in his faunal list (107, tab. 5). Bartzsch et al. (2001: 104, fig. N1–16, 111) recorded *Palmatolepis linguiformis* in the section of Kahlleite Quarry near Rodersdorf (studied by M. Gereke), and an upper *linguiformis* Zone interval without the index species in the section of Vogelsberg Quarry near Göschitz (studied by E. Schindler and the late W. Ziegler) — it is interesting to see this knowledge coming back as a new result to Thuringia, where in reality it was born already 38 years ago. Based on rich unpublished faunas from the Vogelsberg and Kahlleite sections, Bartzsch et al. (2002: 310, fig. 2, 312) reported the *linguiformis* Zone (with its index conodont) from the uppermost layers of the Vogelsberg Formation, just below the Upper Kellwasser Horizon.

In the Geipel Quarry of Schleiz, latest Frasnian conodonts including *Palmatolepis linguiformis* were recovered from Bed 4, immediately below the Upper Kellwasser Horizon. This bed is extremely rich in conodonts throughout, but *Palmatolepis linguiformis* appears not earlier than in the middle part of the bed (level 4B). This allows us to precisely define the base of the latest Frasnian *linguiformis* Zone, which starts as elsewhere shortly before the beginning of the hypoxic Upper Kellwasser bed (Bed 5) emphasising its contemporaneity in palaeogeographically distinct plate units.

Associated conodonts in Bed 4 such as *Palmatolepis bogartensis* (Stauffer, 1938), *Ancyrodella curvata* (Branson & Mehl, 1934), *Ancyrognathus asymmetricus* (Ulrich & Bassler, 1926) and *Palmatolepis rhenana* Bischoff, 1956 (figured on plate 1) are abundant in the *Palmatolepis linguiformis* Zone as expected from the standard zonation Ziegler & Sandberg (1990), and in MN Zone 13 (Klapper, 1989). Comparing the taxonomic diversity and abundance conodont biofacies indicates clear dominance of palmatoolepid that tends to increaseaugment towards the top of the Bed 4 at the expense of *Polynagathus*. This trend is seen in offshore sections including Coumiac, Montagne Noire (Girard & Feist, 1997), Mrirt, Moroccan Meseta (Lazreq, 1992), and Steinbruch Schmidt, Rhenish Slate Mountains (Sandberg et al. 1988), and may correspond to a general sea-level rise prior to the Upper Kellwasser event level.
Trilobites

The first determined trilobite from the Late Frasnian of the Geipel Quarry is *Phacops acuticeps* (Zimmermann 1915: 41). Trilobites collected by Schindewolf, in ca. 1920 were attributed by Richter & Richter (1926: 285) to "Proetus" (gen.? sp. indet., *Harpes neogracilis* and *Phacops* (*Cryphops*) *acuticeps*). Müller (1956) logged and sampled the section in great detail, and in the process discovered Frasnian trilobites [*Phacops* (*Cryphops*) *acuticeps* and *Phacops* (*Phacops*) *cryphoides*] in the last 40 cm (Bed 4) below the Upper Kellwasser Horizon (Bed 5).

Exhaustive collecting from the same bed by one of us (D.W.) garnered 77 trilobite specimens of *Harpes neogracilis* and sampled the section in great detail, and in 1913 (9.1%); the remaining 6.5% represents pygidia of an undetermined phacopid species (*Phacops cryphoides* Richter, 1924). This fauna (Pl. 1: Fig. 1–10) though poorly diversified typically occurs in the latest Frasnian before its extinction at the base of the Upper Kellwasser Horizon both in the Rhenish Slate Mountains and Harz Mountains (Steinbruch Schmidt, Beul, Sessacker, Acke) and on the North Gondwana margin (Coumiac, Mrirt) (Feist & Schindler 1994, Feist 2002). It is characterized in particular by trends to eye reduction that let to blindness in last representatives of *Palpebra* in the *Palmatolepis linguiformis* Zone. The spectacular regression and inconstancy in the number of eye-lenses in *Acucryphops* observed in Coumiac and Mrirt exist also in Schleiz where in Bed 4 morphs with a maximum number of 14 lenses and a minimum of 5 lenses (mean: 9.15) co-occur. However the material is insufficient as to decide whether there is a trend in mean eye-lens reduction within Bed 4A–C. In comparison to contemporaneous faunas from Coumiac and Mrirt the population in Bed 4 is distinct by a poorer taxonomic diversity, a predominance of *Acucryphops acuticeps* that outnumbers by far the other taxa, and the much higher mean number of eye-lenses (unlike the populations in Coumiac and Mrirt where most morphs possess less than 6 lenses). It can be stated with new evidence from Thuringia that last trilobite populations from deeper outer shelf habitats that precede the Upper Kellwasser extinction exhibit evolutionary trends to eye-reduction globally but to different extent depending on local environmental conditions.

Corals

Zimmermann (1915: 41, "kleine Einzelkorallen, *Cyathophyllum* sp.") found the first Rugosa at Geipel Quarry. Schindewolf studied one of these specimens and some additional corals of his own including a few thin sections of the genus *Metriophyllum* (unpublished material in Berlin museums). Weyer (1984: 18) recorded rich new, but so far unstudied samples from the Late Frasnian cephalopod limestone facies of the Berga Anticline (Geipel and Vogelsberg Quarries), with *Metriophyllum, Metriaxon, Metrioplexus, and Neaxon*-like taxa. The occurrence of *Metriophyllum* (Bartisch et al. 2002: 311) in the Vogelsberg Formation refers to unpublished collections of Weyer from three localities (Geipel Quarry in Schleiz, Vogelsberg Quarry near Göschitz, Kahlleite Quarry near Rödersdorf).

The community of Rugosa corals (Fig. 2A–H) from Bed 4 of Geipel Quarry in Schleiz consists of undescribed taxa and includes *Neaxon* Kullmann, 1965, *Petraiia* Münster, 1839, *Metriaxon* Glinski, 1963, *Metriophyllum* Milne-Edwards & Haime, 1850, at least two new genera, and some breviseptoid/ampleximorph taxa. However, current taxonomic studies will be based predominantly on the much richer and better preserved material of the neighbouring locality Vogelsberg Quarry near Göschitz; there the same coral species were also found in somewhat older beds.

Fig. 2. Rugosa (Anthozoa) from the uppermost Frasnian cephalopod limestones (Vogelsberg Formation, bed no. 4) in the Geipel Quarry of Schleiz, NW flank of Berga Anticline, Thuringian Mountains, coll. Weyer 1995 (Museum of Natural History, Humboldt University, Berlin). Palmatolepis linguiformis Zone (bed 4C – Fig. D), top of Late Palmatolepis rhenana Zone (bed 4A – Figs. B–C, E–H), and undifferentiated same Late Frasnian interval (bed 4 – Fig. A). A, Neaxon sp., subtabular cross section. × 10. B–C. Petraia? sp., subtabular and calicular cross sections, × 8 and × 7. D. nov. gen. nov. sp. I, subtabular cross section, × 12. E–F. nov. gen. nov. sp. II. subtabular cross sections. × 9. G. Metrionax sp., subtabular cross section, × 12. H. Metriophyllum sp., subtabular cross section. × 8.

(below the Lower Kellwasser Horizon). The first new genus (I) with a remarkable axial structure is close to the Colummaxoninae Weyer, 1980 (related to Laccophyllinae Grabau, 1928, within the Cyathaxoniidae Milne-Edwards & Haime, 1850). To date the sole similar and comparable taxon is Cyathaxonia? hercynica Roemer, 1855 from the Middle Givetian (Weyer & Zagora 1990: 27, fig. 3); this rare species occurs from the Harz and Rhenish Mountains in Germany to southern France (Montagne Noire) and Morocco (Anti-Atlas). The second new genus (II) with strong axial trabeculae and a slightly inconstant aulos belongs to the Neaxon group. Metriophyllum is used in the revised interpretation of Weyer (1996: 86), being a member of the Lindstroemiidae Počta 1902, close to Lindstroemia Nicholson & Thomson, 1876 (with synonym Lo- pholasma Simpson 1900).

Worldwide, psychospheric coral associations of this Cyathaxonia facies type (sensu Hill 1938: 5–12) remained nearly unknown in the Frasnian (and also in the Givetian). Therefore, Sorauf & Pedder (1986: 1267) speculated about a possible late origin of basinal faunas in the Famenian, but they existed throughout all the Devonian (and Silurian), and were described only exceptionally by very few authors, often of ancient times without modern morphological revisions. The first thorough record for the Early Frasnian (including now late Givetian Pharciceras beds) in ammonoid facies was given, already in the period before use of thin sections, by Ludwig (1865–1866: 9 nearly forgotten, never redescribed coral taxa from the Rhenish Mountains). Weissermel (1939) introduced 3 new taxa from the Thuringian Mountains, based on poorly preserved steinkern samples in the stratigraphically well studied sections of Volk (1939). More adequate studies (with thin sections) start with Stainbrook (1946: Iowa), Soshkina (1952: Ural Mountains), Bulvanker (1958: Kuznezk Basin), Holwill (1964: Western Europe), and Ivaniya (1965: Kuznezk Basin) up to the lately paper of Hill & Jell (1971: Canning Basin) they described new species of Amplexus, Caninia, Catactotoechus, Metriophyllum, Nalivkinella, Nicholsoniella, Syringaxon. Perhaps, Syringaxon independense Stainbrook, 1946 can be transferred to Petraia Münster, 1839 (in the revised sense of Weyer, 2000). At present and momentary, the diverse Late Frasnian Rugosa assemblage from the Thuringian Mountains seems to be unique in the world.
Conclusions

The presence of *Palmatolepis linguiformis*, the index taxon of the latest Frasnian *Palmatolepis linguiformis* Zone, is documented in Thuringia, a part of the Armorican Plate Assemblage. As in the Avalonian Rhenish Slate Mountains it occurs immediately below the Upper Kellwasser Horizon and is associated, as elsewhere, with the same widely distributed trilobite association characterized by trends towards reduced sight. By contrast, the presence of a diversified deep-water coral fauna in the same level is unusual and poorly known from sections outside Thuringia.

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