Biostratigraphy — The faunal province of the southern margin of the Rheic Ocean

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After almost two centuries of geological studies in Saxo-Thuringia, fossil finds are rare and irregularly distributed in sequences ranging in age from the Ediacaran to the Early Carboniferous. For certain periods, a distinct endemism complicates biostratigraphical zonations as well as palaeobiogeographical correlations with other areas.

From the Ediacaran, eponymous macrofossils are not known and the palyno-assemblages are of low or ambiguous stratigraphic and palaeo-geographic significance.

Due to the incomplete preservation of Cambrian sequences, Cambrian faunas are known in Saxo-Thuringia from few locations only. For instance, archaeocyath and small shelly fossil assemblages with archaeocyath-calcimicrobial bioconstructions of Issendalenian age are documented only from Lusatia and Northern Saxony. The oldest known trilobite is also Issendalenian. Middle Cambrian faunas (Agdzian and Caesaraugustan) are commonly found in drill cores of the Torgau-Delitzsch-Doberlug Syncline, where they usually

occur as moderately diverse assemblages with trilobites, brachiopods, and hyoliths. An earliest Middle Cambrian (= early Atdzian) assemblage with trilobites and brachiopods is the only report of faunas of that stratigraphic level in Central Europe. The Franco-Thuringian Slate Belt has various faunas with trilobites, brachiopods, and hyoliths (particularly from the Franconian Forest area), which represent at least six different stratigraphic intervals throughout the Middle Cambrian. However, metazoan body fossils of unequivocal Late Cambrian (Furongian) age are unknown. The Cambrian trilobite faunas of Saxo-Thuringia have a distinct Gondwanan (or peri-Gondwanan) aspect in the Early and early Middle Cambrian and became progressively similar to Baltic faunas during the Middle Cambrian. Whether this change in biogeographic character reflects a geographic shift of the crustal segment is uncertain.

Macro- and microfossils are only rarely reported from Ordovician sequences of Saxo-Thuringia, and are restricted to a few fossiliferous horizons. Fairly rich trilobite and brachiopod associations are described from the early Tremadocian Leimitz Formation and the late Tremadocian Vogtendorf Formation from allochthonous units of the Franconian Forest, Bavaria. A few inarticulate brachiopods are known from the late Tremadocian of Thuringia and Lusatia. Biostratigraphically significant Ordovician graptolites are only documented from the Schwarzburg Anticline (Thuringia) and are restricted to the Araneograptus murrayi and Expansograptus hirundo biozones (late Tremadocian and late Arenig - Dapingian to early Darriwilian, respectively). The latter horizon also yields a small trilobite fauna. Comprehensive reports on Middle to Late Ordovician conodont and Late Ordovician ostracod faunas exist mainly from subsurface samples of former mining areas of the Schwarzburg Anticline. Poorly to moderately preserved palynomorph assemblages (acritarchs, chitinozoans, cryptospores) are known from different horizons of Thuringia, Bavaria, and Saxony throughout the Ordovician. The few known graptolite, conodont, and ostracod faunas indicate a position in higher latitudes for Saxo-Thuringia during the entire Ordovician Period. There are close similarities of the trilobite (and in part the brachiopod) assemblages with Bohemia, the Mediterranean Subprovince (peri-Gondwanan), and even with south China, but to a lesser extent with Baltica. Among the palynomorphs, particularly the late Tremadocian to early Arenig (Floian) acritarch assemblages are of a peri-Gondwanan affinity, corresponding with palyno-assemblages associated with the Calymenacean-Dalmanitinaeaceae trilobite fauna. Palynofacies differences probably reflect a deepening of the Saxo-Thuringian shelf from the present NW (Schwarzburg Anticline) toward the SE (Vogtland, Frankenberg area, Franconian Forest).

In Saxo-Thuringia, the Silurian is represented by the Gräfenwarth Group, a tri-partite succession reaching into the Early Devonian. The succession includes the Unterer Grazierlithenschiefer Formation, Ockerkalk/Orthocerenkalk formation (as well as their lithological equivalents), and Oberer Graptolithenschiefer Formation. The biostratigraphy of the Silurian is almost entirely based on the rich graptolite faunas in the Unterer and Oberer Graptolithenschiefer formations, the faunas of which have been investigated for more than 150 years. The Unterer Graptolithenschiefer ranges from the Parakidograptus acuminatus Biozone to the Neodiversograptus nilssoni Biozone, whereas the Oberer Graptolithenschiefer bears a fauna of the Istrigaptus transgrediens Biozone at the base and ranges further through the Monograptus uniformis to the Monograptus hercynicus biozones of Early Devonian age. The Lippelsdorf 17/64 borehole provided conodonts of the Ancoradella ploeckensis or Polygnatoideas siluricus, Ozarkodina remschiedensis and Oulodus elegans detorted zones in the Ockerkalk Formation. Whereas graptolites and a few other planktonic organisms can be found in the shales of the Unterer and Oberer Graptolithenschiefer formations, benthic faunas dominate the Ockerkalk. Scarce faunas of biostratigraphically relevant conodonts and rich, but only ecologically useful, endemic ostracods occur in the Ockerkalk. Biogeographic information from the graptolite associations indicate the mid-latitude cool-water peri-Gondwanan graptolite province that is spread widely over the Variscan terranes from Spain, Portugal, and the Carnic Alps to Sardinia and Bohemia, which shows distinct differences from the warm-water circumpolar graptolite province. However, in the Late Silurian
the faunal provincialism disappeared and the Early Devonian graptolite faunas are uniform.

Lower and Middle Devonian sediments of the outer shelf and slope were deposited in a relatively uniform basin in Saxo-Thuringia. The poorly fossiliferous sequences (Thuringian Facies) consist of dark, partly anoxic shales, rare shaley carbonates, and intercalated sandstones. In contrast, the Upper Devonian basin was more differentiated, caused by mostly submarine bimodal intra-plate volcanism. Several regions can be distinguished due to significant differences in bathymetry and facies, leading to variable bienvvironments. The Autochthonous Domain of the Schwarzburg Anticline (with the Bohlen escarpment near Saalfeld as the most prominent outcrop) is characterized by pelagic basin sedimentation with shales, marlstones, limestones, and sandy intercalations; several beds are poor or rich in microfaunas and – only occasionally – also in macrofaunals. The SE Wrench and Thrust Zone of the Berga Anticline (mainly Pörmitz Fold Zone in the Schleiz area), however, belongs predominantly to an outer shelf facies with narrow changes due to volcanic swells. Typical are cephalopod limestones bearing many zonal ammonoids and rich conodont faunas. Rocks of the outer shelf facies of the Allochthonous Domain of Saxo-Thuringia are mostly distributed in Franconia and Saxony (Bavarian Facies). Besides of condensed limestones, there occur cherts; the sequences are strongly deflected by intensive Variscan thrusting.

The Devonian micro- and macrofaunas are mostly attributed to the Hercynian Facies (of deeper and cold water), in contrast to the rare Saxo-Thuringian communities of the shallow water Rhenish Facies (with brachiopods, hermatypic corals, and ostracods of the Eifelian ecotype). Hercynian biozonation is based on conodonts (Lochkovian–Famennian), ammonoids (Frasnian–Famennian), graptolites (Lochkovian), tentaculites (Lochkovian–Frasnian), trilobites (Pragian–Famennian), and ostracods (of the planktonic entomozoid ecotype in the Frasnian–Famennian and of the psycosphaeric Thuringian ecotype in the Pragian–Famennian). No distinct faunal provincialism is established in the entire Devonian; presumed differences seem to reflect facies changes or poor data.

Saxo-Thuringian faunas of the Hercynian Facies are related to coeval occurrences in Europe (Iberia, Armorica, the Barrandian, Avalonia), in north-eastern Africa (Morocco, Algeria), and – being sometimes nearly cosmopolitan – even in more distant regions (Iran, South China, Laurentia).

During the Early Carboniferous, remnants of the former widespread marine realm (Rheic Ocean) still existed between peri-Gondwana in the south and the margins of Laurussia to the north. Due to Variscan collision, these basins are only fragmentarily preserved. Among them, the Franco-Thuringian Slate Belt constitutes one of the largest and best exposed tectonic structures of Saxo-Thuringia, as well as the margins of the Erzgebirge, the Lausitz, and the Schwarzwald. The predominantly anchimetamorphic overprinted flysch sequences have extremely few index fossils that are irregularly distributed within the several kilometer thick rock column. On the peri-Gondwanan outer shelf and slope, the Late Devonian pelagic sedimentation with cephalopod limestones and cypridinae shales (Cypridinenschliefer) continued up to the Gattendorfia genozone (lower early Tournaissian, early Hastarian), yielding richer faunas (with stratigraphically important ammonoids, trilobites, ostracods, and conodonts). The suc-ceeding pre-flysch phase was characterized by black shales, reflecting starved sedimentation, with locally intercalated keratophyre tuffs. Rare conodonts, radiolarians, and ammonoids indicate an upper early Tournaissian (late Hastarian) and a lower late Tournaissian age (early Ivorian). The Variscan flysch phase started during the upper late Tournaissian (late Ivorian) and finished either in the middle Viséan (Holkerten) or in the lower late Viséan (Asbian). The sequences are mostly barren of index fossils. Local turbiditic and olistolith occurrence of shallow water limestones (Kohlenkalk) yield foraminifères, corals, and other fossils of the photic zone, reflecting shelf margin source areas. During the late Viséan, internal molasse basins developed, as those preserved along the northern Erzgebirge margin. Their sediments are partially dated by macro- and microfloras.
The Ediacaran Period (Cadamonian basement)
T.H.

The Precambrian biostratigraphy of Saxo-Thuringia will always be associated with the name of Gusti Burmann, who passed away unexpectedly in 2004. Gusti started her successful palynological studies more than 40 years ago in Lusatia (Saxony). She was the first to indicate a Late Precambrian age for the Lusatian greywackes, which were stratigraphically uncertain at that time.

The anchi- to low grade metamorphic flyschoid sequences of the Cadomian basement in Saxo-Thuringia consist of turbiditic greywackes, intercalated with slates, black shales, cherts, and conglomerates. They are exposed, e.g., in the Schwarzburg Anticline of Thuringia, in Northern Saxony in the area of Leipzig, in the Elbe Zone, and in Lusatia. Numerous boreholes in regions between these outcrop areas penetrated corresponding rocks in the subsurface. The individual regional sequences are lithostratigraphically differentiated into units, i.e., the Katzhütte Group (Schwarzburg Anticline), the Leipzig Group (Northern Saxony), and the Lausitz (Super-) Group, and subunits (e.g., the Rothstein Formation in NE Saxony). Details on the lithostratigraphy can be found in Brause et al. (1997), Kroner et al. (2007), and Linnemann et al. (this volume).

Initially, the age assignment for these basement sequences was controversial, ranging from the Precambrian to the Early Carboniferous. Timofeev (1958) reported the first acritarch assemblages from thermally metamorphosed greywackes of the Elbe Zone and Lusatia as being indicative of an Early or Middle Cambrian age. However, Burmann (1966, 1969) regarded these palynomorphs as laboratory contaminations (for details see Paalits & Heuse, 2000). Subsequent investigations of material from Timofeev's original sampling localities and of samples from various other regions of Saxo-Thuringia yielded associations consisting mostly of small sphaeromorphic specimens (single cells and clusters), filamentous elements, and small acanthomorphic acritarchs with low or ambiguous stratigraphic significance (Burmann, 1966, 1969, 1972a, 1972b; Lorenz & Burmann, 1972; Heiner, 1989; Heuse, 1989b; Weber et al., 1990; Buschmann, 1990, 1995; Heuse et al., 1994b). The following taxa were identified: Bavlinella-type acritarchs, Leiosphaeridia ssp., Micrhystridium-like specimens., aff. Octaeryxium truncatum, Protoliosphaeridium ssp., Trachysphaeridium ssp., and vase-shaped elements. Additionally, species of the systematically problematic mineralized genus Favoosphaera were established (Burmann, 1966, 1969, 1972a, 1972b). All these assemblages were interpreted to be of mostly Neoproterozoic (Ediacaran) age as they lack diagnostic palaeozoic elements. The biostratigraphic age determinations were later confirmed by radiometric datings of tuffs (Buschmann et al., 2001). SHRIMP U-Pb ages include values of 574±8 Ma for the Lausitz (Super-) Group and 566±10 Ma for the Rothstein Formation. Additional age determinations from detritic zircons and magmatic pebbles revealed a maximum sedimentation age of about 575-550 Ma (Linnemann et al., 2000, 2004; Gehmlich, 2003).

Dietrich (1967) reported chitinozoans from the Altenfeld Formation (Katzhütte Group, Schwarzburg Anticline), while Dietrich (1967) and Molek (1968) discussed chitinozoans and Palaeozoic acritarchs from the Rothstein Formation (Lusatia). The specimens show only a vague morphological similarity with chitinozoans or acritarchs and cannot be identified convincingly as fossil remains. The putative palynomorphs lack any certain attributes of chitinozoan tegument or an acritarch test. Later studies did not reproduce comparable results.

Burmann (1997a, 1998, 2000, 2001a, 2001b) and Burmann et al. (1997) carried out more recent investigations of the fossil content of the Cadomian basement of Lusatia and Bohemia. They established some new taxa of mineralized and organic-walled macro- and microfossils, and undertook efforts to subdivide the sedimentary sequences biostratigraphically. According to the International Code of Botanical Nomenclature (I.C.B.N., Tokyo Code; Greuter et al., 1994: Article 36.3., p. 49), all taxa are invalid, unfortunately, because their systematic descriptions or diagnoses were given in German and not in English or Latin. Although most of the newly described taxa are considered to be non-fossils herein (e.g., Palisadia wagneri, Dubrvingia lobstii, Buculatiphora ssp., Kobylysa konzalovi), some of them may represent mineralized fossil remains of the new order Silicobacteri,
(Favososphiacres sensu lato), or organic-walled fossils or fossil remains (Palisadispora wagneri, Dubringispora erraticia). Nevertheless, a biostratigraphic zonation for the Cadomian basement of Saxo-Thuringia and a correlation with adjacent regions, as it was suggested in Burmann (1997b, 2000, 2001a, 2001b), has to be rejected due to the dubious character of the fossil remains.

Highly diversified Early to Middle Ediacaran acritarch assemblages with often large and morphologically complex specimens were reported from several platforms: from China (e.g., Zang, 1992; Zang & Walter, 1992a; Zhang et al., 1998), from Australia (e.g., Zang & Walter, 1992b; Zang, 1995; Grey et al., 2003; Grey, 2005; Willman et al., 2006), from Siberia (e.g., Moczydłowska et al., 1993; Moczydlowska, 2005), from Baltica (e.g., Vidal, 1990), from Svalbard (Knoll, 1992), and from other regions. Regional biozonations were established (e.g., Grey, 2005; Willman et al., 2006). These palyno-assemblages are considered to be partly benthic. They disappeared already before the end of the Ediacaran Period, succeeded by less diversified associations dominated by sphaeromorphic specimens with few small acanthomorphic forms (e.g., Grey, 2005; Peterson & Butterfield, 2005; Yin & Yuan, 2007). Reports of comparable morphologically complex assemblages are actually missing from contemporary sedimentary basins of the active Cadomian-Avalonian belt, except for the large acritarch (800 μm) found by Deunff et al. (1973) in Erquy outcrops in Brittany, and proved now to be Ediacaran in age according to the SHRIMP U/Pb dating by Cocherie et al. (2001). Apart from the subsequent thermo-metamorphic overprint, the causes for these differences – primary biological or secondary taphonomic – remain unsolved, but might be partly explained by a significantly different environmental facies. Turbiditic basin sedimentation with considerably higher depositional rates, reducing the preservational potential of organic matter, stands in sharp contrast to the stable platform regions such as in South China, Australia, and Siberia. Consequently, proposed biozonations for the Ediacaran of the Cadomian-Avalonian belt lack significance due to the limited palynological record, as well as poor correlations with other platform regions.

Cambrian biostratigraphy

O.E. & G.G.

Biostratigraphic data for Cambrian rocks of the Central European Variscides are generally sparse. For Saxo-Thuringia, such data concentrate on two regions (Fig. 1): 1 an eastern region with Lusatia and northern Saxony (plus adjacent small areas in Saxony-Anhalt and Brandenburg) and 2 a southwestern region of the Franco-Thuringian Slate Belt (Fränkisch-Thüringisches Schiefergebirge).

Lusatia and Northern Saxony (NW Wrench and Thrust Zone)

Cambrian rocks are preserved in Lusatia and northern Saxony. Although the mode of preservation is quite different between the two regions, comparable lithologies and a common fauna suggest a uniform depositional regime.

Görlitz Syncline

The Görlitz Syncline of Lusatia is a Variscan wildflysch sequence dominated by Carboniferous Culm-type deposits. Cambrian sedimentary rocks are preserved as large olistoliths so that the stratigraphic successions are a priori limited.

The Cambrian of the Görlitz Syncline is incomplete and represents only a short stratigraphic episode, which is lithostratigraphically known as the Charlottenhof Formation. The deepest (and oldest) part of this formation (the lower Ludwigsdorf Member) is characterized by massive and coarse dolostones. Former reports and interpretations of isolated remains (as archaeocyaths by Schwarzbach, 1934a, or stromatolites by Hermendorf, pers. comm.) are unsustainable after critical re-evaluation (Elicki, 1997).

This lower Ludwigsdorf Member is overlain by bedded and partly nodular limestones and claystone intercalations (upper Ludwigsdorf Member). Some horizons are rich in shelly fossils (Fig. 2) such as poriferid spicules, hyoliths, echinoderms, bivalves (Pojetaia runegarti, Fordilla germanica, Fordilla troynensis), helcionelloids (Obtusoconus sp., Planutenia flectata, Planutenia inclinata, Anabarella australis, Bemella aff. jacutica, Bemella
Delitzsch-Torgau-Doberlug Syncline

The Cambrian rocks of the Delitzsch-Torgau-Doberlug Syncline do not represent a continuous succession. Deposition during the Cambrian sedimentation starts after a stratigraphic and structural gap (Cadamian unconformity) with local conglomerates (debris flows), followed by Early Cambrian shallow marine carbonates and minor siliciclastics (Zwethau Formation, Falkenberg Group; Freyer & Suhr, 1987; Elicki, 1992, 1999a, 1999b; Buschmann et al., 1995).

The Lower Cambrian Zwethau Formation is of shallow marine carbonates and siliciclastics. The lower part of the succession (Torgau Member) consists predominantly of carbonates whereas the upper part (Rosenfeld Member) has alternations of siliciclastic-carbonate rocks and pure siliciclastics. The Torgau Member consists of fossiliferous and partly oolitic or intraclastic limestones and dolostones with common calcimicrobial biogenic carbonates. Widespread fossils (Fig. 3) are archaeocyaths such as Ajicayathus paracompositus, Cordibicyathus germanicus, Coccinocysthus? sp., Degeletticyathus? sp., Dictyocysthus stipatus, Erismacosinus tainius, Erismacosinus aff. primus, Inessocysthus freyeri, Neocolicysthus magnus, Nochoroicyathus sp., Protopharetra gemmata, Protopharetra dissuta, Retecoscopus aff. guadalquivirensis, and Urcyathus perejoni, and cyanobacteria and other calcimicrobes such as Renalis sp., Kordephyton sp., Epiphyton sp., Girvanella sp., Botomaelia sp., Subtilifera (= Botominella) sp., and Proualopora cf. glabra (Freyer & Suhr, 1987, 1992; Elicki & Debrenne, 1993; Elicki, 1999a). The archaeocyath genera and some of the species were found in the Issendalienen of Iberia (Ovetian in the regional Iberian nomenclature) and, to a lesser extent, southern Morocco. Faunal relations also seem to exist to the archaeocyaths known from the Normandy.

Bilaterian skeletal fossils were also recovered. Most important is the endemic redlichiid trilobite Dololichia pretiosa Sdzyu, 1962, which was used as an indicator for a mid-Early Cambrian age (Sdzyu, 1962). However, the exact stratigraphic position is a matter of interpretation, and a late Early Cambrian (early Banian) age is plausible.
as well. Other skeletal fossils include inarticulate brachiopods (Acrothele sp.), bradoriids (Hipponicherion elickii and Lipabdomina? sp.), chancelloriids (Chancelloria sp., Archiasterella pentactina, Archiasterella hirundo, Allonia tripodophora, Allonia tetrathallis), and other small shelly fossils (Torellella lentiformis, Torellella curva, Cambroclavus sp., Halkieria sp., Tintinnoidella praecursa, Tiksitheca licis, Cambrotubules cf. decurvatus; Elicki, 1994; Gonzalo & Hinz-Schallreuter, 2002). The occurrence of calcimicrobial-archaeocyathan builds up is remarkable (Freyer & Suhr, 1987; Elicki & Debrenne, 1993; Wotte, 2004). Their age is indicated by archaeocyaths as mid-Early Cambrian (middle Issendalenian [Atlolian] sensu Geyer & Landing, 2004).

Fossils of the Rosenfeld Member include reworked archaeocyaths and small sphaeromorphic and acanthomorphic acritarchs, cyanobacteria and undeterminate shell remains (Schüller, 1949; Freyer & Suhr, 1987; Heiner & Schneider, 1989) that do not permit a precise stratigraphic assignment.

The Middle Cambrian (Arenzheim Group, with the Tröbitz and Delitzsch formations) is represented by siliciclastics with minor carbonate intercalations (Brause, 1969, 1970; Elicki, 1997). Unfortunately, the transition from Lower to Middle Cambrian strata is unknown. This led to the assumption that a significant stratigraphic gap between the strata of the two series is present in this area. However, a newly identified faunal
assemblage from younger strata (see below) reduces this supposed hiatus considerably, which indeed may represent incomplete biostratigraphic data rather than a depositional gap.

The Tröbitz Formation, dominated by quartzitic sandstones alternating with minor micaceous claystones, includes thin calcareous layers at the transition to the overlying Delitzsch Formation. An early Middle Cambrian age is indicated by a comparatively rich fossil association (Fig. 3) with trilobites (Condylonyge regia, Paradoxides (Acadoparadoxides) brausel, Paradoxides (A.) saxonicus, Paradoxides (Eccaparadoxides) cf. pinus, Paradoxides aff. enormis, cf. "Ellipsocephalus incultus, Ornamentaspis? frankenwaldensis, Parasolenoplera lusatica", inarticulate brachiopods (Lingulella ferruginea, Acrothoe quadrilineata), and hyoliths ("Hyolithes" cf. oelandicus) (Sdzuy, 1957a, 1957b, 1958, 1970a, 1972). The trilobites indicate a stratigraphic level equivalent to the Iberian Paradoxides (Eccaparadoxides) sduyi Biozone, corresponding to the middle to upper Agdzian (Celtiberian) sensu Geyer & Landing (2004). Additional fossils are some hyoliths, brachiopods, and trace fossils.

These classical assemblages are now supplemented by a recently identified assemblage with trilobites as such as Protolenus (Hupeolens) aff. termierelloides, Cambrunicornia n. sp., and others as well as inarticulate brachiopods (Trematobolus sp., unidentified acrotretoïd; Buschmann, Elicki & Geyer, unpubl. data, 2006; Geyer & Buschmann, 2006). This fauna features the lowest Middle Cambrian upper Hupeolens and/or lowest Cephalopyge zones (lower Agdzian) and represents the oldest known Middle Cambrian from the Lusatian/Saxonian segment of the Saxo-Thuringian. The strata, identified from a drill-core west of Doberlug-Kirchhain, are in a facies somewhat different from that of the typical Tröbitz Formation.

The overlying Delitzsch Formation consists of dominating quartzitic sandstones alternating with micaceous claystones. As for the Tröbitz Formation, the faunas are dominated by trilobites, inarticulate brachiopods, and hyoliths (Fig. 3). Two different stratigraphic levels can be distinguished. The older level includes the trilobites Condylonyge regia, Peronopsis sp., Paradoxides (Acadoparadoxides) brausel, Paradoxides (Acadoparadoxides) cf. insularis, Paradoxides (Eccaparadoxides) sp.,

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**Fig. 2.** Fossils from the Lower Cambrian of Lusatia, Saxony. All samples were taken in an abandoned quarry near Ludwigsdorf. **1, 5 Serrodiscus silesius** Richter & Richter 1941; **1 cephalon, x 2.5;** Charlottenhof Formation, Lusatiospis Member; SUS 402 (original of Geyer & Elicki, 1995, Fig. 3.1); **5 pygidium with articulated thorax, x 2.5;** Charlottenhof Formation, Lusatiospis Member; FG 410/23 (original of Geyer & Elicki, 1995, Fig. 3.5). **2, 6 Calodiscus cf. lobatus** (Hall 1847); **2 cephalon, x 8;** Charlottenhof Formation, upper Ludwigsdorf Member; FG 410/18 (original of Geyer & Elicki, 1995, Fig. 5.2); **6 pygidium, x 20;** Charlottenhof Formation, upper Ludwigsdorf Member; FG 410/19 (original of Geyer & Elicki, 1995, Fig. 5.4). **3 Ferralsa saxonica** Geyer & Elicki 1995; **3 cephalon, x 3.5;** Charlottenhof Formation, upper Ludwigsdorf Member; FG 410/25 (original of Geyer & Elicki, 1995, Fig. 9.1). **4, 9 Lusatiospis lusaticus** (Schwarzbach 1934); **4 librigena with typical long genal spine, x 2.1;** Charlottenhof Formation, Lusatiospis Member; PIW 94123a (original of Geyer & Elicki, 1995, Fig. 7.2); **9 cephalon, x 2;** Charlottenhof Formation, Lusatiospis Member; PIW 941122 (original of Geyer & Elicki, 1995, Fig. 7.4). **7 Lonalitius pusillus** Missarzhevsky 1981; **7 internal mold, x 55;** Charlottenhof Formation, upper Ludwigsdorf Member; (original of Elicki, 1994, Fig. 5.7). **8 Planulaea flectata** Elicki 1994; **8 internal mold with pseudomorphic shell particles, x 55;** Charlottenhof Formation, upper Ludwigsdorf Member (original of Elicki, 2000, Pl. 1, Fig. 3). **10 Rhabdomiculum cancellatum** (Cobbold 1921); **10 ca. x 70;** Charlottenhof Formation, upper Ludwigsdorf Member (original of Elicki, 1994, Fig. 6.8). **11 Yuwenia juliana** Elicki 1994; **11 internal mold, x 21;** Charlottenhof Formation, upper Ludwigsdorf Member; (original of Elicki, 1996, Pl. 3, Fig. 4). **12 Pelagiella aff. adunca** (He & Pei 1984); **12 internal mold, x 40;** Charlottenhof Formation, upper Ludwigsdorf Member (original of Elicki, 2000, Pl. 1, Fig. 2). **13 Microlonyne cephalata** Bengtsen 1990; **13 possible oocotoral sklerite, x 100;** Charlottenhof Formation, upper Ludwigsdorf Member (original of Elicki, 1994, Fig. 6.12). **14 Pojetaea runnegari** Jell 1980; **14 internal mold, x 23;** Charlottenhof Formation, upper Ludwigsdorf Member (original of Elicki, 1994, Fig. 4.8). **15 Chancelloria primaria** Missarzhevsky 1989; **15 internal mold, x 28;** Charlottenhof Formation, upper Ludwigsdorf Member (original of Elicki, 1994, Fig. 5.12). **16 Beshtashella tortilis** Missarzhevsky 1981; **16 problematic microfossil possibly representing the initial portion of the columella of Yuwenia, ca. x 85;** Charlottenhof Formation, upper Ludwigsdorf Member (original of Elicki, 1994, Fig. 4.4). **17 Dodecaactinella cyanodontata** Bengtsen & Runnegar 1990; **17 ca. x 60;** Charlottenhof Formation, upper Ludwigsdorf Member (original of Elicki, 1994, Fig. 5.13).
Paradoxides aff. enormis, "Ellipsoccephalus" incultus, Parasolenopleura lusatica, Bailiella cf. emarginata, Lingulella! sp. A, "Hyolithes" cf. oelandicus, Orthotheca aff. affinis, Orthotheca sp., and Oxyphyma schloppensis (see Sdzuy, 1970a). This fauna indicates an early Middle Cambrian age equivalent to the younger fauna of the Tröbitz Formation (equivalent to the Iberian Paradoxides (Eccaparadoxides) sduyi Biozone, corresponding to the higher Agdzian sensu Geyer & Landing, 2004). A different fauna includes the trilobites Condylopyge rex, Hypagnostus cf. truncatus, Clavagnostus? sp., Conocoryphe (Parabailiella) schmasti*, Ornamentaspid? annulatus*, Ornamentaspid? cf. annulatus*, Acanthomicmacca anomocaroides*, Dorypyge? sp., Olenoides sp., Conocoryphe (Conocoryphe) palpebralis, Conocoryphe (Conocoryphe) gemina, Solenopleura picardi, Jicella? cf. sulcata, Paradihaemia? sp., Peronopsella inaequalis, Paradoxides aff. asturianus, and Badulesia tenera, the brachiopods Acrorhele sp. and Eoorthis aff. primordialis, and the helcionellloid mollusc Helcionella oblonga (see Sdzuy, 1970a; nomenclature partly revised herein). In fact, several of the taxa (marked with an asterisk) do not fit stratigraphically to this level but represent an older fauna. It remains puzzling whether these taxa were mixed during the sampling process. Others represent a relatively narrow stratigraphic interval of mid-Middle Cambrian age (early Caesaraugustan [Celtiberian] in terms of the West Gondwanan stratigraphic scheme). Most characteristic is the trilobite Badulesia tenera, which is used as an index fossil in Iberia and Morocco and characterizes the Badulesia Zone.

North-Saxon Schist Belt (Autochthonous Domain)

From the North-Saxon Schist Belt (Nordsächsisches Schiefergebirge), a poor fauna was reported from the Collinberg Formation in the vicinity of Borna-Hainichen. The original outcrops are obliterated today. The fauna includes poorly preserved inarticulate brachiopods and some ichnofossils. Based on the trace fossil Cruziana semiplicata, a Late Cambrian to Early Ordovician age has been assumed for the possibly shallow marine siliciclastic shelf deposits (Freyer, 1981b; Elicki, 1997; for additional discussion see Ordovician part). The lower and upper boundaries of the formation are unknown.

Franco-Thuringian Slate Belt

The Franco-Thuringian Slate Belt includes Cambrian and likely Cambrian rocks known from subunits in the eastern (Berga Anticline) and western (Schwarzburg Anticline) region of Thuringia and in northeastern Bavaria (Franconian Forest = Frankenwald).

Two old drillings from the core of the Berga Anticline (SE Wrench and Thrust Zone) near the village of Heinersdorf penetrated Ordovician rocks and reached the Limestone Formation and the underlying, non-penetrated Quartzitic Shale Formation. Both low-grade metamorphic formations are unified into the Heinersdorf Group. Despite its name, the Limestone Formation is developed as an alternation of shales and carbonate intercalations. From these calcareous layers, Blumenstengel (1980) described poorly preserved Cambrian chancellorids, hyoliths, echinoderms, and stromatolites. Particularly the chancellorids suggest an Early to Middle Cambrian age. Regional similarities with well-dated deposits appear to indicate a late Early to early Middle Cambrian age (Elicki, 1997).

For the Schwarzburg Anticline (Autochthonous Domain) an earlier suggested Cambrian age for the Goldisthal Formation was mostly derived from lithostratigraphic correlations. However, new investigations on acritarchs (Heuse in Estrada et al., 1994), regional aspects (Linnemann & Buschmann, 1995), and geochronometric data (Gehmlich et al., 1997; Falk et al., 2000) indicate that the formation falls in the Early Ordovician. Only its oldest beds might reach into the Furongian. However, as a part of the peri-Gondwanan depositional regime, a Late Cambrian deposition is unlikely.
Franconian Forest (Frankenwald, Allochthonous Domain)

The Frankenwald area (Franconian Forest) exposes few Cambrian outcrops of very limited extent. Almost all of the Cambrian localities are fault bounded and usually do not allow to recognize details of the rocks successions. However, the outcrops represent a number of different formations, which are usually fossiliferous and present a relatively complete sequence through the Middle Cambrian. The Lower Cambrian is not recognized with certainty, although its upper part is supposedly represented by the Tiefenbach Formation. Ages of older rock units in the area have not yet been determined. Furongian (Late/Upper Cambrian) rocks are assumed to be absent due to a phase of non-deposition and erosion at the end of the Cambrian. Upper Middle Cambrian rocks are hence unconformably overlain by the Tremadocian Leimitz Formation.

The Lower Cambrian (?) to lowermost Middle Cambrian Tiefenbach Formation (Geyer & Wiegel, 1997) is generally an alternation of quartz-arenites and shales with variable lithologies. Echinoderm debris and trilobite and brachiopod shell hash are reported from some hardgrounds of the lower part of the formation (Ludwig, 1969), but none of the fossil remains permitted a precise determination. The same member shows burrow churning and common vertical burrows of the Skolithos-type.

The Galgenberg Formation (Wurm, 1924, 1925a, 1925b; Sdzuy, 1964; Geyer & Wiegel, 1997) is dominated by various sandstones. The early Middle Cambrian (= early Celtiberian) age is demonstrated by a fauna that occurs in a few layers of fine-grained, calcareous sandstone. This fauna may be rich in individuals, but is not very diverse (Fig. 4). Trilobites dominate this fauna and include Ornamentaspis? frankenwaldensis, Kingaspidoidea sp., Latikingaspis cf. alanus, Parasolenopleura sp. A, Parasolenopleura sp. B, Parasolenopleura sp. C, Bailleia sp., Paradoxides sp., Acanthomysisacca sp., and Wurmaspis rarus. These genera indicate an age of the Cephalopyge and early Ornamentaspis frequens zones (Agdzian of the West Gondwanan standard). Echinoderms are common, including the oldest known stylophoran species (Rahman et al., in press). Additional fossils include brachiopods and hyoliths. Burrow churning and various trace fossils are relatively common.

The lower Middle Cambrian (= lower Celtiberian) Wildenstein Formation (Wurm, 1924, 1925a, 1925b; Sdzuy, 1964; Geyer & Wiegel, 1997) consists generally of greywacke-type sandstones. Relatively rich assemblages of trilobites indicate an age of the late Ornamentaspis frequens to early Kymataspis zones (Agdzian). These trilobites include Paradoxides s. l., Condyloryge, Bailleia, Parasolenopleura, Acanthomysisacca, Ornamentaspis, Kingaspidoidea, and Dawsiaonia. In addition, brachiopods, molluscs, sponge spicules (Calcichactina franca), echinoderm debris (echinoid ossicles), and the problematic Oxyprymna schloppensis were found in these strata.

The Trieibenreuth Formation (von Gaertner et al., 1968; Ludwig, 1969; Geyer & Wiegel, 1997) is known only from two localities. This formation is a volcanogenic to siliciclastic succession dominated by grey to greenish shales and sandstones dovetailed with diabase-keratophyre breccias (Ludwig, 1969). Fossil remains were found in siliceous shales with volcanogenic components but are not yet formally described. The majority includes trilobites (with Conocorypho and Eodicina, Corynexochida, and Ptychopariida), which prove a middle Celtiberian age. Additional fossils are brachiopods and sponge spicules. Algal structures are reported from the volcanogenic conglomerates (Ludwig, 1969).

The middle Middle Cambrian (late Caesaraugustan Lippertsgrän Formation (Wurm, 1928b; Geyer & Wiegel, 1997; Sdzuy, 2000) consists of relatively monotonous shales with some calcareous nodules. Fossils are generally rare and only known from the calcareous layers and nodules. They are usually strongly distorted and incomplete, but fairly rich associations (Fig. 4) with the trilobites Condyloryge rex, Pleurocetinum sp., Hypagnostus sp., Pernopsis sp., Phalagnostus mudus, Hydrocephalus cf. carens, Paradoxides sp., Acontheus inaratus minutus, Bailleia wurni, Bailleia aequalis, Bailleia frantzeni, Bailleia sp. A, Bailleia sp. B, Cionecephalus franconicus, Sao hirsuta, Solenopleuroopsis levisilimbata, and Skeleaspis spinosus (see Sdzuy, 2000). The trilobite assemblage represents a biostratigraphically consistent fauna characteristic...
of the Solenopleuropsis Zone, upper part of the Caesaraugustan with typical species such as Solenopleuropsis levitimbilata (a common species of the Montagne Noire, southern France) and Condolyopygerex, Phalagnostus nudus, or Skreiaspis spinosus (typical for the Barrandian of Bohemia). Bailiella aequalis is a species first described from Sweden, and permits correlation with the upper part of the Paradoxides paradoxisimus stage of Baltica. In addition, cinctar carniopods, eocrinoids, and sponges are common, but only found as disarticulated ossicles and spicules, respectively.

The upper Middle Cambrian (Languedocian) Bergleshof Formation (von Horstig, 1954; Sdzuy, 1966; Geyer & Wiebel, 1997) consists of a quite variable succession of sandstones and siltstones. Layers with accumulated billingsellid brachiopod shells and echinoderm ossicles are known from the formation. In addition, hyoliths ("Orthotheca" sp. and undeterminate hyolithids), echinoderms (the cinctar carniopod Ludwigicinclus truncatus Friedrich 1993), trilobites, common articulate (Billingsella cf. lindstroemi), and rare inarticulate brachiopods ("Eoorthis" sp.) are known from the formation. The trilobites include Peronopsis fallax minor, Leiagnostus sp., Kymataspis sp., Prolampyx ances medianus, Erratojincella cf. brachymetopa, "Parasolenopleura" horstigi, Holocenephalina agrauloides, and Bailiella? glabrate (see Sdzuy, 1966).

Fig. 3. Fossils from the Lower and Middle Cambrian of the Delitzsch-Torgau-Doberlug Syncline. 1 Regular arboecyaths of the Zwethau Formation, Torgau Member, bar = 5 mm; (A) Erismacoccus sp. (cross and longitudinal sections), (B) Cordobicythus germanicus (Elici & Debrènne 1993), (C) Inessascocytus freyaani (Elici & Debrènne 1993); thin section; drilling 230/78 near Herzberg. 2 colony of Epiphyton sp.; probable stigonematalean cyanobacteria, bar = 5 mm; thin section; Zwethau Formation, Torgau Member; drilling 1706/81 near Herzberg. 3 Acrothele sp.; ca. x 5; Zwethau Formation, Torgau Member; drilling T 31 near Doberlug-Kirchhain; ZG Berlin (original of Sdzuy, 1962, PI. I, Fig. 17). 4, 5 Dolorelicha pretiosa Sdzuy 1962; 4 pygidium, x 3.5; 5 cranium, x 1.8; both from Zwethau Formation, Torgau Member; drilling T 29 near Doberlug-Kirchhain; ZG Berlin X 151a (originals of Sdzuy, 1962, PI. I, Figs. 1a, 12). 6 Protolenus (Hupelenus) aff. termierilloides Geyer 1990; cranium, ca. x 1.3; tentatively from Tröbitz Formation; drilling 1209/78 near Doberlug-Kirchhain; coll. TU Bergakademie Freiberg. 7 Cambriumiscopina sp.; cranium, x 3.5; tentatively from Tröbitz Formation; drilling 1209/78 near Doberlug-Kirchhain; coll. TU Bergakademie Freiberg. 8 Paradoxides (Eccaparadoxides) brausei Sdzuy 1970; cranium and thorax, x 0.9; Delitzsch Formation; drilling LS 1/63 near Doberlug-Kirchhain; coll. Geologisches Landesamt Sachsen, Br 1930 (original of Sdzuy, 1970, PI. II, Fig. 1). 9, 10 "Ellipsoccephalus" incultus Sdzuy 1970; immortal cranium, x 6; Delitzsch Formation; drilling LS 1/63 near Doberlug-Kirchhain; coll. Freiberg, Br 2012 (original of Sdzuy, 1970, PI. III, Fig. 4); 10 cranium, x 1.8; Delitzsch Formation; drilling LS 1/63 near Doberlug-Kirchhain; coll. Geologisches Landesamt Sachsen, Br 2012 (original of Sdzuy, 1970, PI. III, Fig. 6). 11 Lingulina sp.; x 4.5; Tröbitz Formation; drilling De 8/63 near Grebehna; coll. Geologisches Landesamt Sachsen (original of Sdzuy, 1970, PI. I, Fig. 3). 12 Orthotheca aff. affinis Holm 1893; operculum, x 6; Delitzsch Formation; drilling LS 1/63 near Doberlug-Kirchhain; coll. Geologisches Landesamt Sachsen, Br 2005 (original of Sdzuy, 1970, PI. I, Fig. 3). 13 "Hyolithes" cf. oelandicus Holm 1893; large deformed conch, x 1.2; Delitzsch Formation; boring LS 1/63 near Doberlug-Kirchhain; coll. Geologisches Landesamt Sachsen, Br 2005 (original of Sdzuy, 1970, PI. I, Fig. 7). 14, 15 Condolyopyge regia (Sjögren 1872); 14 cephalon, x 6; 15 pygidium, x 4.5; both from Delitzsch Formation; drilling LS 1/63 near Doberlug-Kirchhain; coll. Geologisches Landesamt Sachsen, Br 1886 (originals of Sdzuy, 1970, PI. I, Figs. 17, 20). 16 Parasolenopleura lusatica Sdzuy 1970; cranium with articulated partial thorax, x 4; Delitzsch Formation; drilling LS 1/63 near Doberlug-Kirchhain; coll. Geologisches Landesamt Sachsen, Br 1888 (original of Sdzuy, 1970, PI. III, Fig. 8). 17, 20 Bailiella cf. emarginata (Linnarsson 1887); 17 pygidium, x 2.8; 20 partial cranium, x 1.6; both from Delitzsch Formation; drilling LS 1/63 near Doberlug-Kirchhain; coll. Geologisches Landesamt Sachsen, Br 1888, Br 1885 (originals of Sdzuy, 1970, PI. III, Figs. 18, 16). 18 Paradoxides (Acadoparadoxides) saxonicus Sdzuy 1970; cranium, x 0.8; Tröbitz Formation; drilling De 8/63 near Grebehna; coll. Geologisches Landesamt Sachsen (original of Sdzuy, 1970, PI. II, Fig. 10). 19 Paradoxides aff. enormis Sdzuy 1968; partial cranium, x 0.8; Delitzsch Formation; drilling LS 1/63 near Doberlug-Kirchhain; coll. Geologisches Landesamt Sachsen, Br 1939 (original of Sdzuy, 1970, PI. II, Fig. 10). 21 Badulesia tenera Sdzuy 1968; incomplete, enrolled dorsal carapace, x 2.2; Delitzsch Formation; drilling D IV near Doberlug-Kirchhain; coll. Geologisches Landesamt Sachsen.
**Biogeographic implications**

As described above, the known Cambrian fossils in Saxo-Thuringia concentrate on: 1 Lower Cambrian carbonates such as in the Lusatia area; 2 Middle Cambrian shallow marine clastic deposits in the Franconian Forest; and 3 Middle Cambrian deeper marine deposits such as in the Delitzsch-Torgau-Doberlug Syncline.

The **Lusatia area** (Görlitz and Delitzsch-Torgau-Doberlug synclines) presented a wide array of trilobites, archaeocyaths, sclerites and conchs of various other metazoans (commonly lumped as small shelly fossils), and calcimicrobial remains. Most diverse among the associations are the small shelly fossils. The Görlitz faunas share a fairly large number of genera and partly species with associations known from the western Mediterranean (Elicki, 1996, 2000). The (slightly younger) trilobites appear to indicate a best correspondence with coeval trilobites from West Gondwana although there is no perfect match with any of the well-studied areas in Iberia, southern France, or Morocco.

Archaecyath assemblages from the Zwethau Formation of the Delitzsch-Torgau-Doberlug Syncline have been compared with associations from Spain and Morocco, and a comparable stratigraphical level of the middle Issendalenian Stage of the Atlasic Series of West Gondwana has been suggested (Elicki & Debrenne, 1993; Moreno-Eiris et al., 1995; Perejón et al., 2005).

The Franconian Forest offers a relatively complete succession of Middle Cambrian faunas that allows interpretation of biotic relationships to other areas. The oldest fauna includes trilobites of the **Cephalopyge notabilis** Zone with strong affinities to faunas known from the Moroccan.

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Fig. 4. Fossils from the Middle Cambrian of the Franconian Forest (Frankenwald). The specimens were taken from three locations: Galgenberg Formation at Galgenberg to the north of Wildenstein, Lippertsgrün Formation near Lippertsgrün, and Bergleshof Formation to the west of Bergleshof. 1 **Ornamentaspis? frankenwaldensis** (Wrum 1925); distorted cranidium, x 2.8; Galgenberg Formation. 2 **Kingaspidoidea** sp.; cranidium, x 2.2; Galgenberg Formation. 3 **Parasolenopleura** sp. A; incomplete cranidium, x 2.8; Galgenberg Formation. 4 **Oxyprymna schlopensiss**; problematic fossil, possibly an arthropod telson, original size; Galgenberg Formation. 5 **Parasolenopleura** sp. B; slightly distorted dorsal carapace, x 1.6; Galgenberg Formation. 6 **Condylopyge rex** (Barrande 1846); cephalon and deformed pygidium, x 3.8; Lippertsgrün Formation; SMF 57603 (original of Sdzuy, 2000, Pl. 1, Fig. 3). 7 **Phalagnostus nudus** (Beyrich 1845); pygidium, latex cast of external mold, x 3.5; Lippertsgrün Formation; SMF 57621 (original of Sdzuy, 2000, Pl. 2, Fig. 6). 8 Sao hirsuta (Barrande 1846); cranidium, x 8; Lippertsgrün Formation; SMF 57667 (original of Sdzuy, 2000, Pl. 5, Fig. 8). 9, 10 **Solenoeurospis ivesiiiformans** Thoral 1948; 9 partial cranidium, x 3.8; Lippertsgrün Formation; SMF 57675 (original of Sdzuy, 2000, Pl. 6, Fig. 4); 10 librigena, x 4.5; Lippertsgrün Formation; SMF 57679 (original of Sdzuy, 2000, Pl. 6, Fig. 8). 11 **Ctenocephalus francoicus** Sdzuy 2000; cephalon, x 5.2; Lippertsgrün Formation; SMF 57659 (original of Sdzuy, 2000, Pl. 4, Fig. 12). 12 **Skreiaspis spinosus** (Jahn 1895); cranidium (computed reconstruction of distorted partial cranidium), x 4.5; Lippertsgrün Formation; SMF 57682 (original of Sdzuy, 2000, Pl. 7, Fig. 9). 13 eocrinoid ossicle, x 5.5; Lippertsgrün Formation; SMF 57685 (original of Sdzuy, 2000, Pl. 6, Fig. 11). 14 eocrinoid ossicle, x 5.5; Lippertsgrün Formation; SMF 57686 (original of Sdzuy, 2000, Pl. 6, Fig. 12). 15 **Leiagnostus** sp.; pygidium, x 4; Bergleshof Formation; SMF 2001le1 (original of Sdzuy, 1966, Pl. 8, Fig. 6). 16 **Acontheus inamatus minitus** Sdzuy 2000; cranidium, x 11; Lippertsgrün Formation; SMF 57638 (original of Sdzuy, 2000, Pl. 3, Fig. 5). 17 **Bailiella wurni** Sdzuy 2000; cranidium, x 2.7; Lippertsgrün Formation; SMF 57653 (original of Sdzuy, 2000, Pl. 4, Fig. 7a). 18, 19, 23 **P同盟x anceps medianus** Sdzuy 1966; 18 immature cranidium, x 2.5; Bergleshof Formation; SMF 20014a (original of Sdzuy, 1966, Pl. 8, Fig. 9); 19 mature cranidium, x 2; Bergleshof Formation; SMF 20017b (original of Sdzuy, 1966, Pl. 8, Fig. 12); 23 pygidium, x 3; Bergleshof Formation; SMF 20034a (original of Sdzuy, 1966, Pl. 8, Fig. 32). 20 **Kymataspis? snajdri** Sdzuy 1966; cranidium, latex cast of external mold, x 1.2; Bergleshof Formation; SMF 20012 (original of Sdzuy, 1966, Pl. 8, Fig. 7). 21, 24 **Parasolenopleura" horstigi** Sdzuy 1966; 21 immature cranidium, x 3; Bergleshof Formation; SMF 20028 (original of Sdzuy, 1966, Pl. 8, Fig. 28); 24 cranidium, x 3; Bergleshof Formation; SMF 20035a (original of Sdzuy, 1966, Pl. 9, Fig. 2). 22 **Bailiella? giibata** (Angelina 1854); pygidium, x 1.2; Bergleshof Formation; SMF 20054a (original of Sdzuy, 1966, Pl. 9, Fig. 22). 25 **Holocephalina agrauloides** Sdzuy 1966; cranidium, x 2.5; Bergleshof Formation; SMF 20046a (original of Sdzuy, 1966, Pl. 9, Fig. 9). 26 lumachelic sandstone with many internal and external molds of **Billingssella cf. lindstroemi**; x 0.75; Bergleshof Formation; SMF 20049a4 (original of Sdzuy, 1966, Pl. 10, Fig. 6).
Anti-Atlas and High Atlas ranges. A strong similarity to West Gondwanan trilobite faunas from Spain and Morocco exists for the Wildenstein Formation. However, the similarities with mainland Gondwana decrease in the younger formations of the Franconian Forest, whereas the number of Bohemian taxa in these formations increases. The maximum similarity with Bohemian association exists for the middle Middle Cambrian trilobite faunas from the Lippertsgrün Formation, although there occur also faunal elements known from Sweden. For the late Middle Cambrian Bergleshof Formation, the trilobites show strong resemblance with faunas described from the Erratijinella brachymetopa Zone of the P. forchhammeri Stage of Baltica. This similarity may be in part the result of a lithofacies control despite deposition on a shallow shelf. Nevertheless, it clearly indicates that the strong Gondwanan affinities of the faunas have been lost in the late Middle Cambrian and replaced by Baltic affinities.

Faunas from the Middle Cambrian of the Delitzsch-Torgau-Doberlug Syncline represent two different stratigraphic levels. The older, Hupoelemus Zone fossils from the Tröbitz Formation are too sparse and too poorly studied yet to permit a distinct interpretation. The known trilobites, however, have a distinctly Gondwanan aspect. The younger, middle Middle Cambrian faunas from the Tröbitz and Delitzsch formations, in contrast, are a clear mixture of a certain amount of Gondwanan trilobites and a slightly larger amount of Bohemian-type trilobites with several endemic taxa.

Based on the limited information, these aspects strongly suggest that known Cambrian faunas of the Saxo-Thuringian are of Gondwanan (or peri-Gondwanan) character in the Early and early Middle Cambrian, with progressive similarity with Bohemian faunas towards the middle Middle Cambrian. A slight increase of Baltic faunal elements appears to culminate towards the late Middle Cambrian. Whether this change in biogeographic character reflects a geographic shift of the crustal segment needs to be reconfirmed by additional data. However, it would offer the most parsimonious explanation for this distinct development in faunal composition.

**Orдовician biostratigraphy**

T.H., G.G., J.M.

First records of Orдовician fossils were given by Gümbel (1864) for Saxo-Thuringia, Barrande (1868) and Pompeckj (1896) for Franconia, Geinitz (1873) for Lusatia, and Loretz (1880) for Thuringia. The lithostratigraphic subdivision of the Orдовician – at that time attributed to the Lower Silurian – based on publications of Geinitz (1853a) on Lusatia, Richter (1869a) on Thuringia, Gümbel (1879) on Thuringia and Franconia, and other publications. A historical overview of the development of the litho- and biostratigraphy of Germany was presented by the Stratigraphische Kommission Deutschlands (1997, 2001a, 2001b). Selected stratigraphic schemes for the German Orдовician were compiled in the Stratigraphic Table of Germany (Leonhardt et al., 2005; Heuse & Maletz, 2005). Large areas of Saxo-Thuringia consist of metamorphic complexes without or with only an insignificant record of index fossils. These predominantly tectonostratigraphic units have been also revised in above mentioned compilations.

Despite almost two centuries of fossil collection, macro- and microfossils of biostratigraphic significance remain rare in the Orдовician sequences of Saxo-Thuringia, and are restricted to a few fossiliferous horizons. A review of biostratigraphically significant macro- and microfossils was given by Heuse (2000) and is updated herein.

Two different sedimentary and magmatic features of the Palaeozoic (Orдовician-Devonian) are recognizable in Saxo-Thuringia and are attributed to different facies developments. The so-called Thuringian Facies has been interpreted as produced in a widespread homogenous basin, with dominantly siliciclastic sedimentary environment. The so-called Bavarian Facies has been regarded as more differentiated, comprising siliciclastics as well as magmatic rocks. Orдовician sequences attributed to the Thuringian Facies occur exclusively within the Autochthonous Domain and in the Wrench and Thrust Zones and partly as klippen or windows within olistoliths of the Allochthonous Domain. The Thuringian Facies is established in the Schwarzburg and Berga anticlines, as well as in parts of the Franconian
Pre-Mesozoic Geology of Saxo-Thuringia

From the Cadomian Active Margin to the Variscan Orogen

Edited by
Ulf Linnemann and Rolf L. Romer

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