

The Coburg Sandstone member (Hassberge Formation, Carnian, Triassic) in Frankonia: The Hahn Quarry near Eltmann

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Locality:

Hahn Quarry southeast of Eltmann (figure 1),
Bamberger Natursteinwerk Hermann Graser.

Source of the "Weisser Mainsandstein".

Coordinates: 49° 57' 37.7400 N, 10° 40' 22.8000 E and R44 04 890 H 55 36 850, respectively.

Introduction:

The Coburg Sandstone member from Hassberge and Steigerwald of Franconia (northern Bavaria, Germany) is the upper part of the Blasensandstein (Hassberge-Formation, Tuvalian, Carnian, Triassic), an equivalent of the Kieselsandstein from Baden-Württemberg (figure 5). The succession belongs to the so-called Vindelian Keuper (figure 2): alluvial clastics, derived from the Vindelian and Bohemian High in the SE interfinger basins into non-marine dolomitic claystones and siltstones and dolomites, the playa lake environment of the inner Central European Basin (figure 3). All the terrigenous Keuper deposits above the Schilfsandstein consist of detritus from the Vindelicean-Bohemian Massif (PAUL et al. 2008).

Coburg Sandstein quarries in Steigerwald and Hassberge reveal non-marine successions of grey channel and sheet sandstones with intercalated laminated lacustrine sediments of light grey, greenish, yellow and red colours, partly showing small scale cyclicity. Economically important is an approx. 2-4 m thick basic layer of fine grained sandstone, the so called "Haupt-Werkstein" (FREYBERG 1965), also named "Unterbank" *sensu* FREUDENBERGER et al. 2000, FREUDENBERGER 2005.

Delicate compression and impression fossils are not common in the Frankonian Coburg sandstone, they are exclusively preserved in intercalated clay- and siltstones. But fine-laminated bedding characteristics therein are often destroyed caused by the process of pedogenesis and peloturbation. Driven by wetting and drying, soils rich in clay with large capacities for expansion tend in dry seasons to crack widely and deeply. Soil crumbs, granules and organic particles falling from the surface mulch layer into the cracks to lower soil layers. If this happened repeatedly in a longer period of time, the whole soil is turned over.

Also the mudstone red and violet colours are of secondary origin and generated by pedogenic overprinting (MADER 1990).

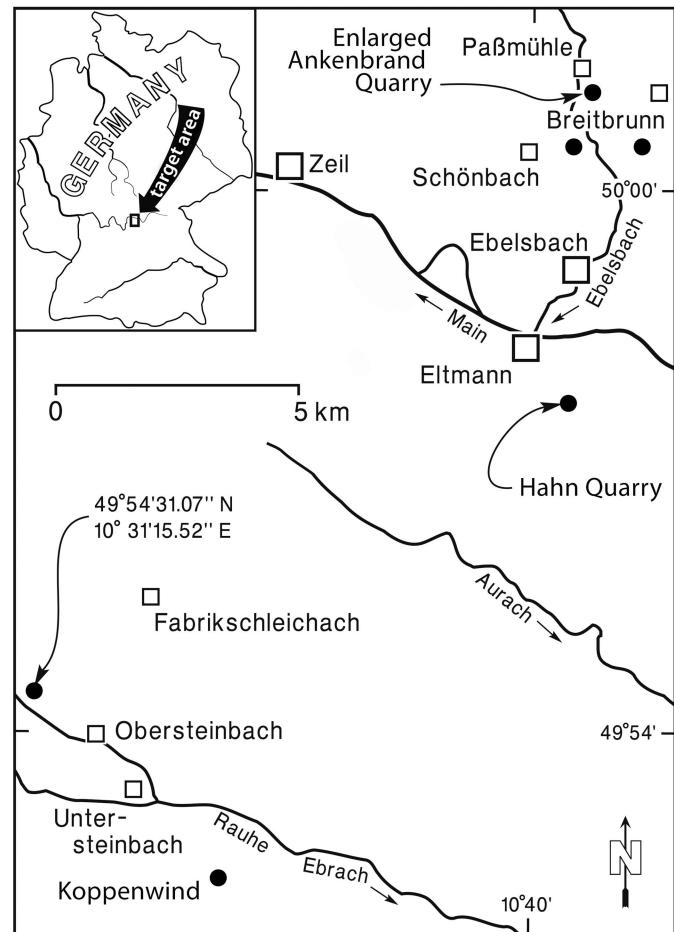


Fig. 1. Location of the Hahn quarry near Eltmann (Bamberger Natursteinwerk Hermann Graser), and of some other fossiliferous Coburg sandstone quarries in Steigerwald and along the Ebelsbach valley.

Special points of discussion and selected relevant literature concerning the Frankonian Coburg Sandstone member

Geological overviews:

GEYER 2002; ETZOLD & SCHWEITZER 2005; NITSCH 2005a; FEIST-BURKHARDT et al. 2008.

Concerning lithostratigraphy:

FREYBERG 1965a; STAHL 1971; BLANKMEISTER 1989; BÜTTNER 1995; BACHMANN & KOZUR 2004; BEUTLER 2005; FREUDENBERGER 2000, 2005; GEYER & SCHMDT-KALER 2006; PAUL et al. 2008.

Concerning facies development, sedimentation and sediment structures:

Sediment structures such as oscillation ripples, mud cracks, and so forth.

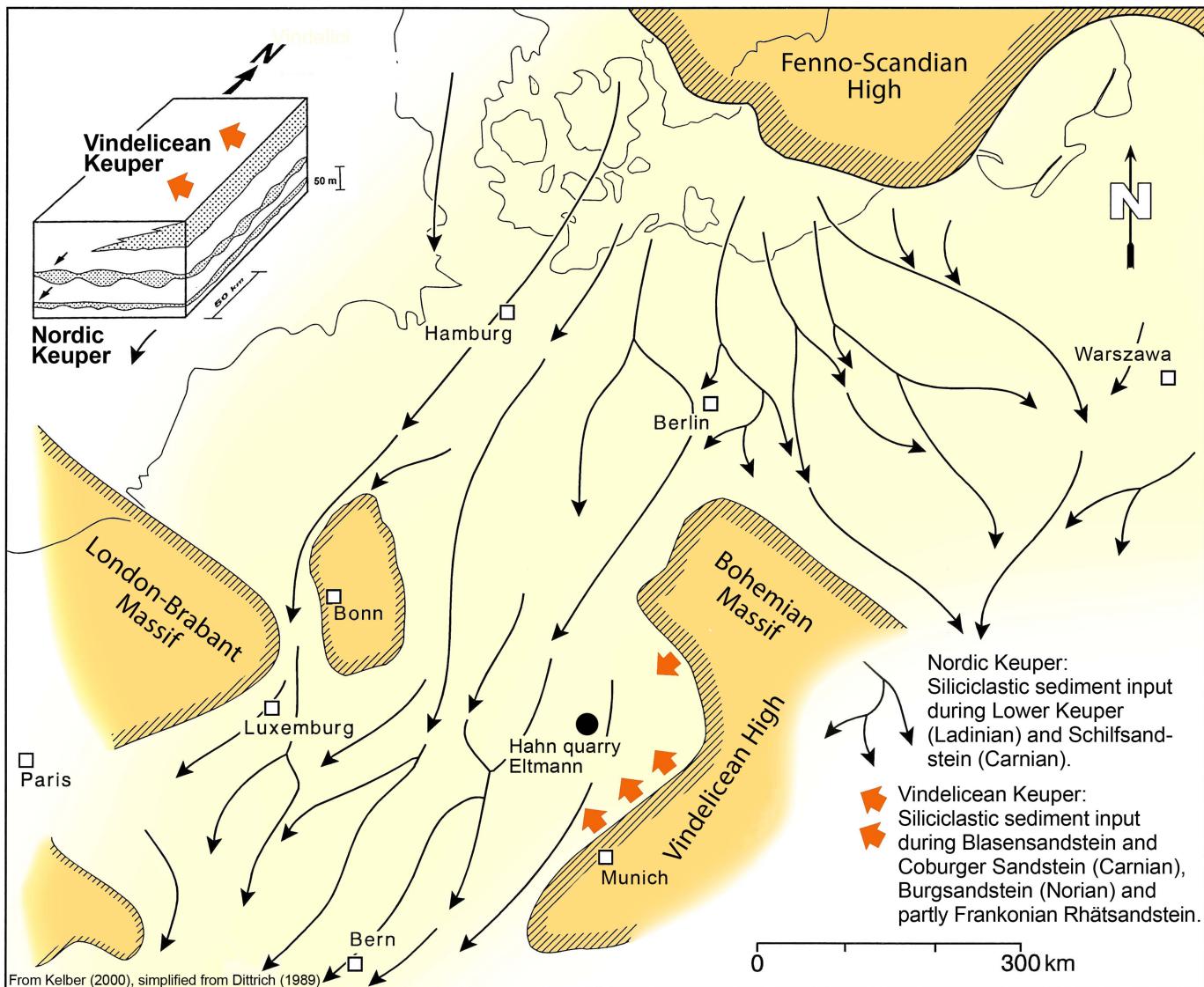


Fig. 2. Schematic palaeogeographic reconstruction of the Upper Triassic Central European Basin showing source areas and transport directions of siliciclastic sediments during the Nordic and Vindelicean Keuper. Compiled after DITTRICH 1989; from KELBER 2000, slightly altered.

Comprehensive reviews of the Frankonian Coburg sandstone have been provided by FREYBERG 1965a, STAHL 1971, MADER 1990, GEYER 2002.

Recent contributions have noticeably increased the sedimentological knowledge:

AIGNER & BACHMANN 1992; KERN & AIGNER 1997; BEUTLER et al. 1999; HORNUNG & AIGNER 2004; BEUTLER & NITSCH 2005; ETZOLD & SCHWEITZER 2005.

For palaeoclimatological interpretations see KERN & AIGNER 1997; REINHARDT & RICKEN 2000; BEUTLER & NITSCH 2005; NITSCH 2005.

Concerning the usage of Coburg Sandstone ("Weisser Mainsandstein"):

BLANKMEISTER 1989; WEINIG 1986; GRIMM 1990.

Concerning halite crystal marks (plate 1a):

JAKOB 1983; HAUSCHKE & VATH 2003.

Concerning palaeosols and root traces:

Root traces not to be mistaken with *Skolithos* isp.!

MADER 1990; NITSCH 2005b.

Concerning ichnofossils:

A diverse array of ichnofossils, e.g. *Skolithos*, *Rhusophycus*, *Cruciana*.

FREYBERG 1965a; SCHLIRF et al. 2001.

Concerning vertebrate foot tracks:

The material from the Coburger Sandstein of Germany is the first documented evidence of the ichnogenus *Apatopus* from the Triassic of the Germanic Basin. The Coburger Sandstein has provided the type material of *Brachychirotherium* as well as tridactyl footprints assigned to *Atreipus-Grallator* (plate 1b) and small lacertoid imprints of *Rhynchosauroides*.

KARL & HAUBOLD 1998, 2000; WERNEBURG 1998; HAUBOLD & KLEIN 2000; KLEIN & HAUBOLD 2003; KLEIN & LUCAS 2013.

Concerning vertebrates (from the Jailhouse Quarry Ebrach):

KUHN 1936; SULEJ 2002; BUTLER et al. 2014.

Concerning fishes (plate 3a):

DEHM 1956; FREYBERG 1965b; DOERT & ROSSNER 1985; LÓPEZ-ARBARELLO 2008.

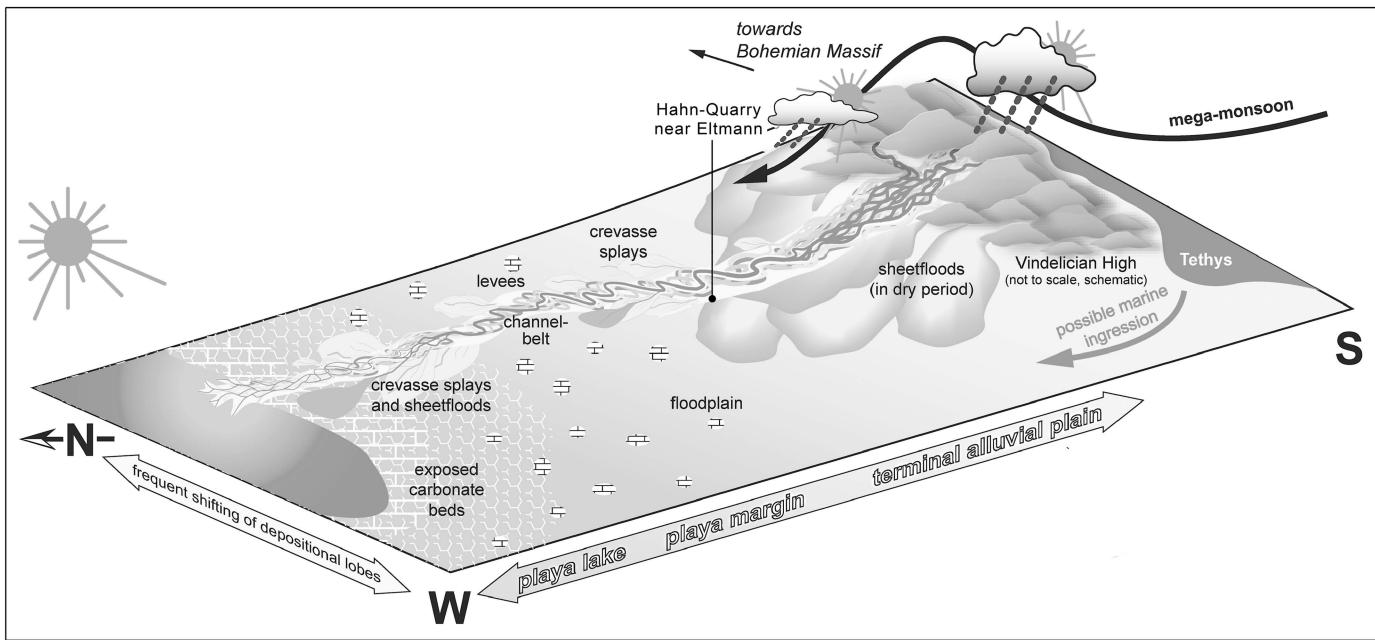


Fig. 3. Conceptual depositional model of SW Germany during the Upper Triassic Middle Keuper in the SW part of the Germanic Basin. Facies belts prograde and retrograde due to variations in mega-monsoonal strength. Significant changes of wet and dry periods entirely reorganized the facies patterns, including sheet floods in dry periods. Possible marine ingestions in some distinct horizons may have occurred. Taken from FEIST-BURKHARDT et al. 2008, slightly changed.

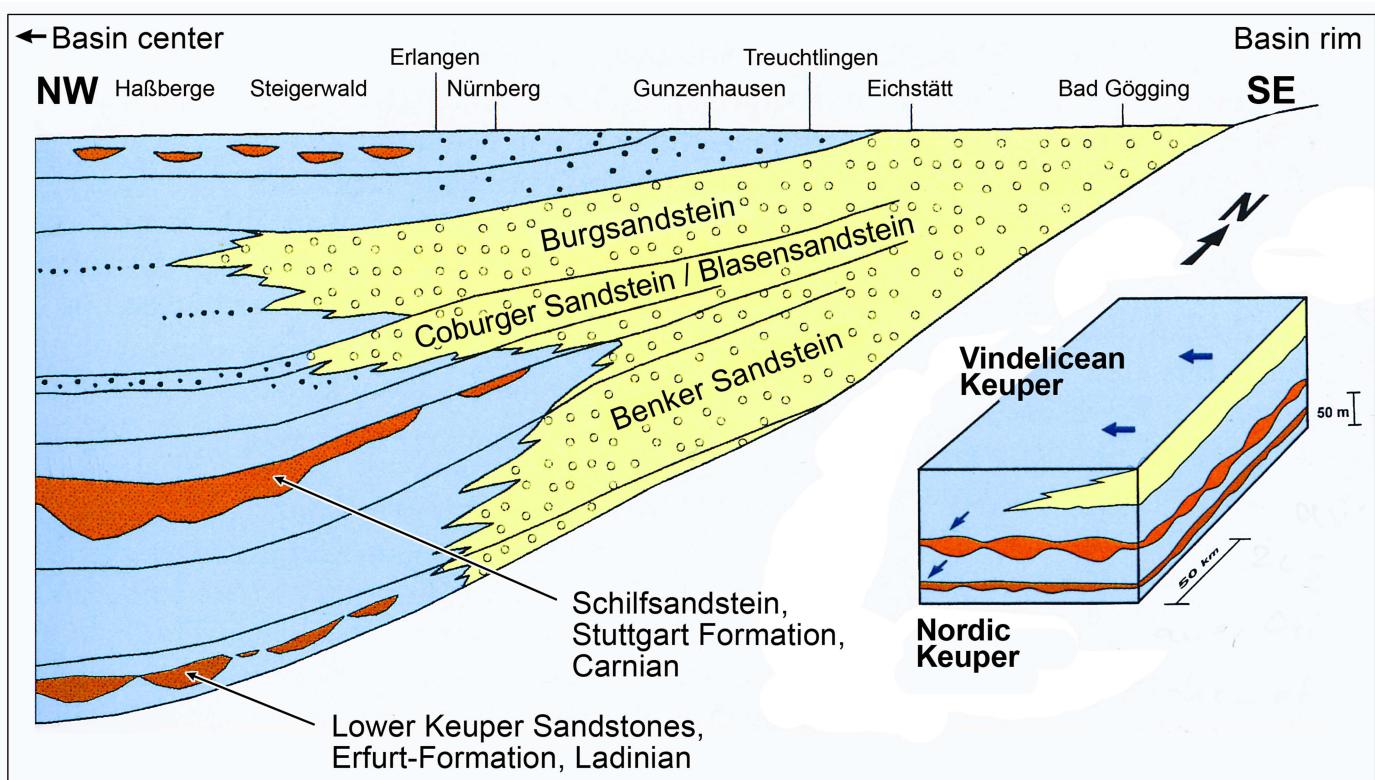


Fig. 4. Simplified section of the Keuper beds in southern Germany from the basin rim near the Vindelicean High towards the basin center. Cross-section reveals that lithostratigraphy is guided by the interfingering of fluvial sand tongues with clay and carbonate beds of the playa system. From GEYER & SCHMIDT-KALER 2006, slightly altered.

Concerning tadpole shrimps (Triopsidae, Notostraca, Crustacea):

"*Triops cancriformis*" and the living fossil concept (plate 3b, d, h).

TRUSHEIM 1937; KELBER 1998, 1999a; SEEGIS 1999; KELBER & NITSCH 2005; WAGNER et al. 2017, 2018.

Concerning clam shrimps (spinicaudatan Branchiopods, „Conchostracans“):

Especially their use in a fine-scaled biostratigraphic framework (plate 3c, f, g).

KOZUR & WEEMS 2007; GEYER & KELBER 2018.

Concerning insects (plate 3e):

PROKIN et al. 2013; PONOMARENKO et al. 2015.

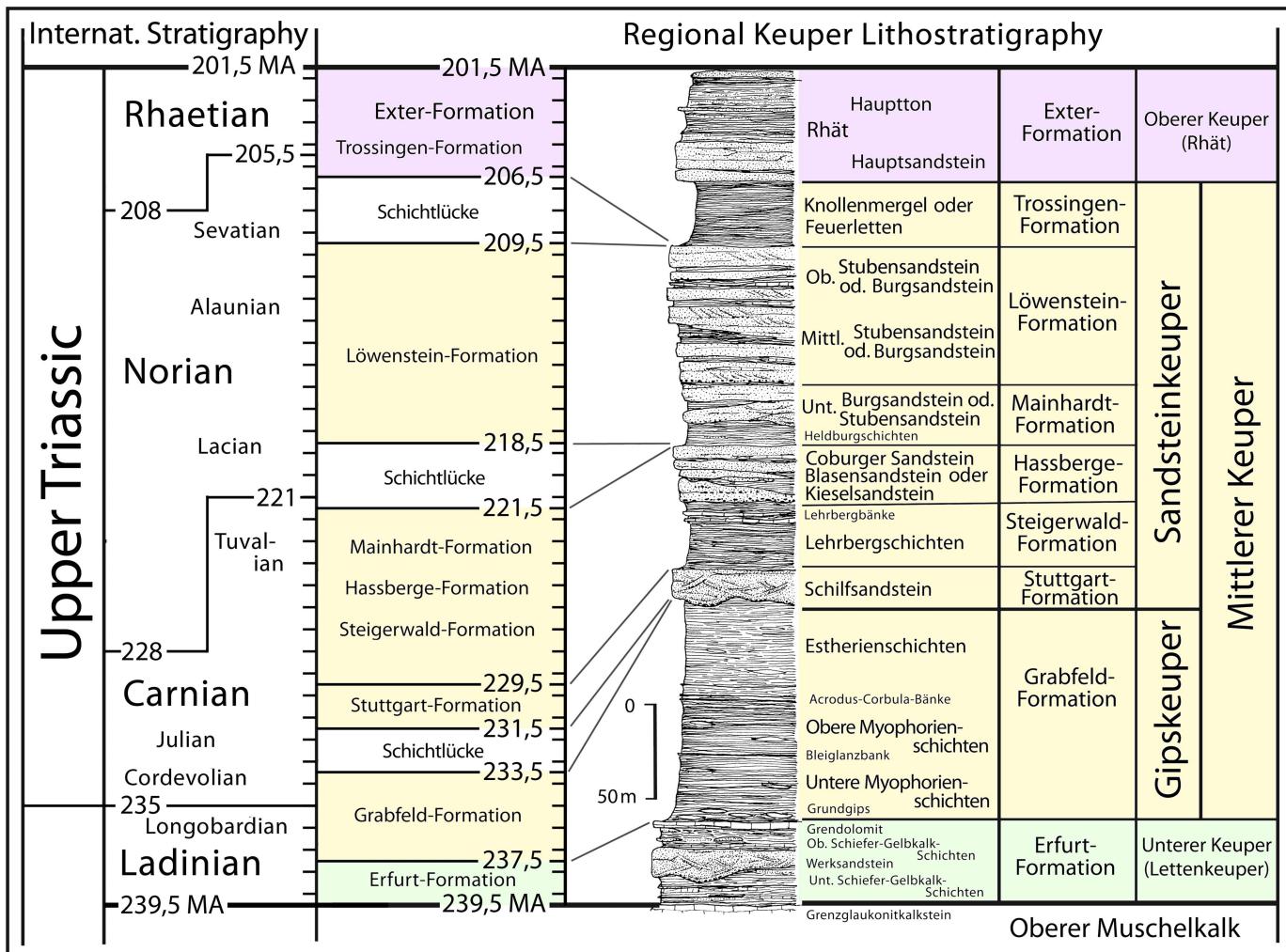


Fig. 5. A composite column showing the Keuper lithostratigraphic members in southern Germany and its stages and substages (right hand side; after Bachmann & Kozur 2004). Left hand side showing correlation with Triassic chronostratigraphy and numerical ages (data taken by Deutsche Stratigraphische Kommission 2016). Keuper time span (38 MA) is twice as long as the Muschelkalk, Buntsandstein, and Zechstein together!

Concerning macroplants (plate 2, plate 3e):

Conifers became highly diverse in the Coburg Sandstone flora. The onset of the Cheirolepidiaceae! First finds of most probable Ginkgophyta (*Eoginkgoites*) and Cycads or Bennettitales (plate 2).

MÄGDEFRAU 1953, 1956, 1963; FREYBERG 1965b; KELBER & HANSCH 1995; KELBER 2005, 2007.

Concerning fossil charcoal (plate 1d-g):

An extraordinary palaeoecological dimension is given by finds of fractured cubic charcoal pieces (fusain). They are black and brittle, with silky luster and display open tracheid cells (plate 1e). SEM and reflective microscopy of cell walls shows evidence of cell wall homogenisation. Charcoal chunks were resistant to sediment compression and remain more or less three-dimensionally preserved (plate 1d). The tissue of wood are converted into almost pure carbon, and hence become biologically inert and chemically resistant to decay as well as prone to long distance fluvial transportation.

The superb charcoal preservation enables wood detail analysis, e.g. in revealing uniserrate separate bordered pits (plate 1g) and pit aper-

ture characteristic in cross-field pits (plate 1f).

The charcolified wood remains, sourced from fire prone coniferopsid upland forests, suggest that wildfire was an important environmental factor in the Coburg Sandstone ecosystem.

Abundant quantities of charcoal together with *Semionotus bergeri* (plate 3a) and other fish remains from the Hahn Quarry near Eltmann are interpreted as the result of a local catastrophic wildfire. Erosion after wildfire might have induced nutrient flux into the water body. Then eutrophic processes have led to low oxygen levels and triggered out a massive fish kill.

KELBER 1999b, 2007; UHL & MONTENARI 2011.

Concerning palynomorphs:

WILLE 2000.

Other field trip guides discussing the Frankonian Coburg Sandstone member:

BACHMANN et al. 1998; KELBER 2000; REIMANN & SCHMIDT-KALER 2002; HORNUNG & AIGNER 2004; KELBER & NITSCH 2005; GEYER & SCHMDT-KALER 2006.

Acknowledgement:

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Plate 1. Fossil charcoal, casts of halite crystals and ichnofossils from Coburg Sandstone member, Hassberge Formation, Carnian (deposited in collection K.-P. Kelber, Würzburg). Scale bars 1 cm.

- a. Cubic reliefs, casts of halite crystals (halite crystal marks), DÖR-201. Gleussner Quarry near Dörfis.
- b. Tridactyl dinosauroid pes impression *Atreipus* isp., SCHÖ-98. Vetter Quarry near Schönbachsmühle.
- c. Ichnofossil *Rusophycus carbonarius*. Vetter Quarry near Schönbachsmühle.
- d. Fossil charcoal, PASS-344. Note the leafy conifer twig preserved as compression, flattened by sediment compaction, in comparison to the nearly undisturbed charcoal clast in 3D preservation. Enlarged Ankenbrand Quarry near Paßmühle.
- e. Fossil charcoal, cf. *Araucarioxylon keuperianum*, SEM photograph. Cross section showing open tracheids. Note the small vertical growth ring structure (smaller tracheids). Enlarged Ankenbrand Quarry near Paßmühle.
- f. Fossil charcoal, *Araucarioxylon keuperianum*, SEM photograph. Radial section showing vertical tracheids, horizontal ray cell walls and cross-fields with oculipores. Enlarged Ankenbrand Quarry near Paßmühle.
- g. Fossil charcoal, *Araucarioxylon keuperianum*, SEM photograph. Radial section showing uniseriate pit pori.



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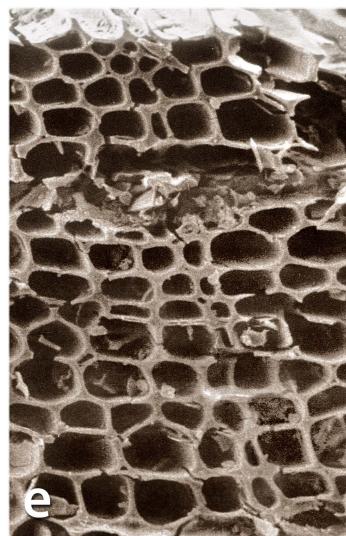
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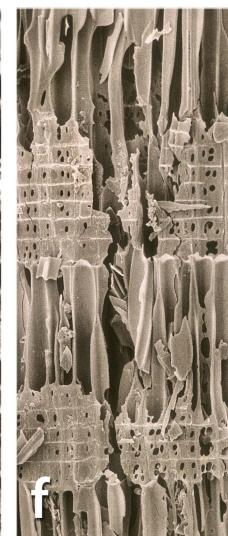
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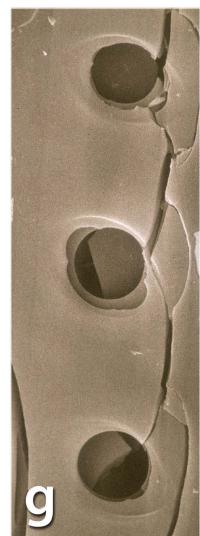
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Plate 1

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Plate 2. Plant macrofossils from Coburg Sandstone member, Hassberge Formation, Carnian (deposited in collection K.-P. Kelber, Würzburg). Scale bars 1 cm.

- a. *Equisetites arenaceus*, DÖR-44. Leaf sheath. Gleussner Quarry near Dörfis.
- b. *Pterophyllum brevipenne*, SCHÖ-1. Impression of a fragmented frond. Vetter Quarry near Schönbachsmühle.
- c. *Elatocladus* sp., leafy conifer twig. Enlarged Ankenbrand Quarry near Paßmühle.
- d. „*Glyptolepis*“ *platisperma*, PASS-54b. Ovuliferous scale (cone scale), adaxial view. Enlarged Ankenbrand Quarry near Paßmühle.
- e. „*Glyptolepis*“ *platisperma*, PASS-57. Ovuliferous scale (cone scale). Abaxial view showing two ovule attachments. Enlarged Ankenbrand Quarry near Paßmühle.
- f. *Albertia* sp., PASS-58; leafy conifer twig. Enlarged Ankenbrand Quarry near Paßmühle.
- g. gen. et sp. indet., SCHÖ-5. Big unknown fruit or seed (Cycadales? Bennettitales?), in pith cast preservation. Vetter Quarry near Schönbachsmühle.
- h. gen. et sp. indet., unknown bifid ovule; Quarry Hermannsberg near Breitbrunn.
- i. gen. et sp. indet., ELT-56b. Undescribed coniferous cone scale. Hahn Quarry near Eltmann.
- j. Plant debris, consisting mainly of singular coniferous flower parts. Hahn Quarry near Eltmann.
- k. *Voltzia coburgensis*, Mold and pith cast preservation of fossil conifer wood. Pith cast ornamented with elongated rhomboids. Enlarged Ankenbrand Quarry near Paßmühle.
- l. cf. *Czekanowskia* sp., (Czekanowskiales), PASS-60; fragmented single leaf. Enlarged Ankenbrand Quarry near Paßmühle.
- m. *Eoginkgoites* sp., ELT-68; single leaf. Hahn Quarry near Eltmann.



Plate 2

WEINIG, H. 1986. Die Sandsteine der Hassberge. Vorkommen, Abbau und Verwendung. – Naturwissenschaftliches Jahrbuch Schweinfurt 4: 25-45.

WERNEBURG, R.: 1998. Neufund einer Dinosaurierfährte aus dem Coburger Sandstein (M. Keuper) von der Schönbachsmühle (Franken). – Veröffentlichungen Naturhistorisches Museum Schleusingen 13, 15-18.

WILLE, W.: Sporen, Pollen und Algen aus dem Coburger Sandstein (Mittelkeuper) von Franken.- Abstract, 27. Jahrestagung des Arbeitskreises für Paläobotanik und Palynologie (Tübingen, 12.-15. Mai 1999). Rundbrief 31: 71-72.

Plate 3. Animal fossils from Coburg Sandstone member, Hassberge Formation, Carnian (deposited in collection K.-P. Kelber, Würzburg). Scale bar in fig. a, d, e, =1 cm; fig. b =3 mm; fig. c, f =2 mm.

- a. *Semionotus bergeri* (Actinopterygii, Semionotiformes). Hahn Quarry near Eltmann.
- b. Fragmented tadpole shrimp *Triops cancriformis*, (Notostraca, Crustacea), showing abdomen, telson and caudal furca. Hahn Quarry near Eltmann.
- c. Clam shrimp *Laxitextella freybergi* (Spinicaudata, Crustacea), ELT-C-04a. Hahn Quarry near Eltmann.
- d. Tadpole shrimp *Triops cancriformis*, (Notostraca, Crustacea), PASS-211a, dorsal view. Enlarged Ankenbrand Quarry near Paßmühle.
- e. Plant detritus and leafy coniferous twigs of *Voltzia coburgensis*, ELT-135. Red arrow point to the impression of a dotted beetle elytron (Coleoptera, Insecta). Hahn Quarry near Eltmann.
- f. Clam shrimp *Gregoriussella striatula* (Spinicaudata, Crustacea). ELT-C-04b. Hahn Quarry near Eltmann.
- g. Detail from fig. f, showing radial lirae vertical to growth lines.
- h. *Triops cancriformis*, (Notostraca, Crustacea). Nearly complete specimen. Ventral view, showing subventral plate, labium, mandibles, weak impressions of thoracic appendages and antennae. Enlarged Ankenbrand Quarry near Paßmühle.

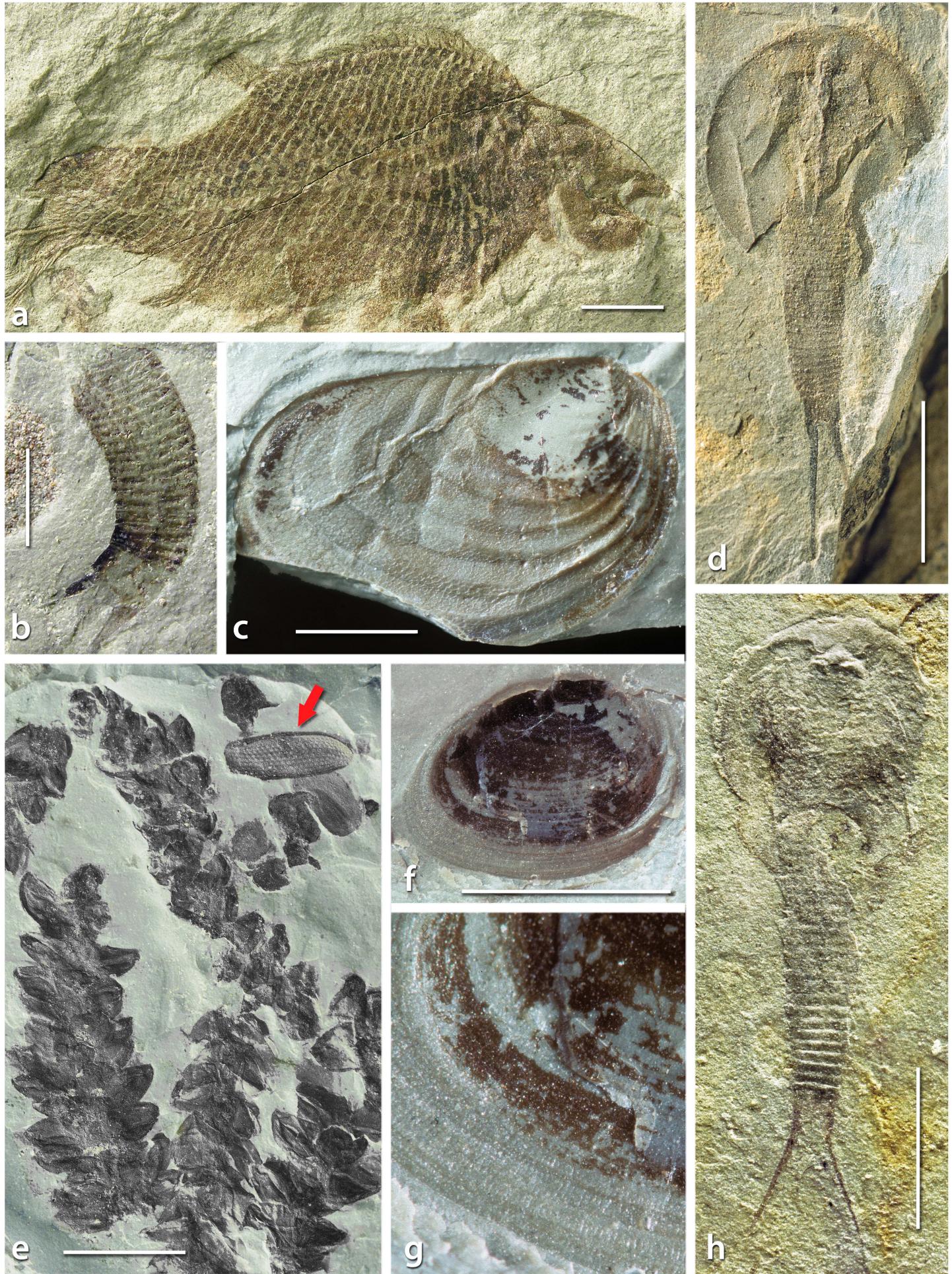


Plate 3