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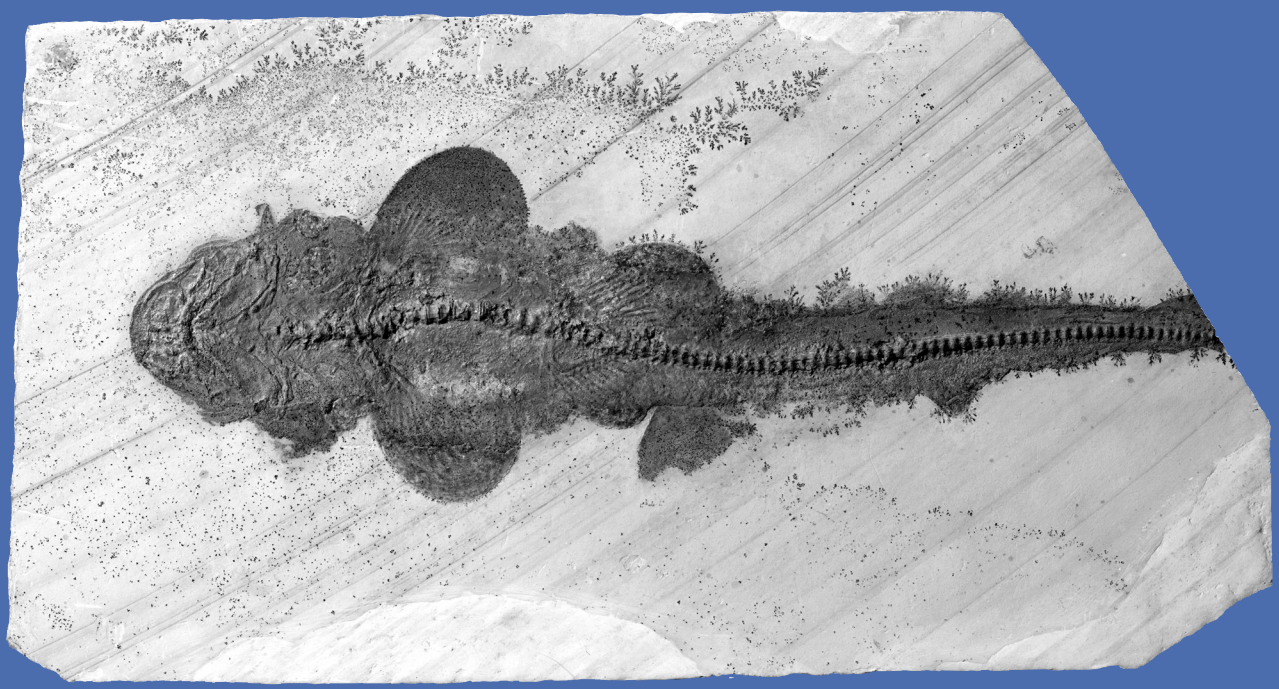

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EDITORIAL NOTE

As of in 2003, the journal *Zitteliana* is published in two series.

Series A: *Mitteilungen der Bayerischen Staatssammlung für Paläontologie und Geologie* (ISSN 1612-412X) replaces the former „Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie“ (ISSN 0077-2070). The numbering of issues is continued (last published: Heft 43, 2003).

Series B: *Abhandlungen der Bayerischen Staatssammlung für Paläontologie und Geologie* (ISSN 1612-4138) continues the previous „Zitteliana – Abhandlungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie“ (ISSN 0373-9627).

Instructions for authors are included at the end of this volume.

HINWEIS DES HERAUSGEBERS

Vom Jahr 2003 an erscheint die Zeitschrift *Zitteliana* in zwei Reihen.

Die *Reihe A*: *Mitteilungen der Bayerischen Staatssammlung für Paläontologie und Geologie* (ISSN 1612-412X) ersetzt die bisherigen „Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie“ (ISSN 0077-2070). Die Bandzählung (zuletzt erschienen: Heft 43, 2003) wird fortgesetzt.

Die Reihe B: *Abhandlungen der Bayerischen Staatssammlung für aPaläontologie und Geologie* (ISSN 1612-4138) führt die bisherige „Zitteliana – Abhandlungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie“ (ISSN 0373-9627) fort.

Hinweise für Autoren beider Reihen sind am Ende dieses Bandes enthalten.

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Cover illustration: *Phorcynis catulina* Thiollière, 1854 (BSP 1990 XVIII 51) from the lower Tithonian of Zandt / Denkendorf (Bavaria), ventral view, 25 cm. Photograph: G. Janßen (LMU München, Department für Geo- und Umweltwissenschaften, Sektion Paläontologie)

Umschlagbild: *Phorcynis catulina* Thiollière, 1854 (BSP 1990 XVIII 51) aus dem unteren Tithon von Zandt / Denkendorf (Bayern), Ventralansicht, 25 cm. Foto: G. Janßen (LMU München, Department für Geo- und Umweltwissenschaften, Sektion Paläontologie)

Zitteliana	A44	61-65	3 Figs	München, 30.12.2004	ISSN 1612-412X

Macroacaena franconica n. sp. (Crustacea: Brachyura: Raninidae) from the Turonian of S Germany

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Abstract

The first raninid crab described from the Lower Turonian of southern Franconia represents a new species of *Macroacaena* Tucker, 1998, *M. franconica*. The occurrence of this crab extends the range of the genus into the Turonian and points to a deep shelf palaeobathymetric position of southern Franconia in the Early Turonian.

Key words: decapods, palaeoecology, palaeogeography, Upper Cretaceous, Bavaria.

Zusammenfassung

Aus dem Wellheimer Inoceramenquarzit (Unter-Turonium) der südlichen Frankenalb wird erstmals eine Froschkrabbe beschrieben. Sie repräsentiert eine neue Art, die der Gattung *Macroacaena* Tucker, 1998, zugerechnet wird. Sie wird als *M. franconica* n. sp. beschrieben. Das Vorkommen eines Vertreters dieser Krabbengruppe spricht für eine Tiefschelf-Position des Ablagerungsraums während des Unter-Turonium.

Schlüsselwörter: Decapoden, Paläoökologie, Paläogeographie, Ober-Kreide, Bayern.

1. Introduction

Most studies on the extra-alpine Cretaceous of Bavaria have focused on the deposits of the "Gulf of Regensburg" in eastern Bavaria. Other areas have been neglected. The rather poorly preserved fauna and flora of the Cretaceous in southern Franconia was first described and figured by Lehner (1933, 1937). The microfauna has been studied by Groiss (1964), while the sponges were exhaustively analysed by Wagner (1963). Mörs (1991) provided a modern overview of the state of knowledge of the lithology and fossil content. Concerning decapod crustaceans, chelipeds of *Protocallianassa* Beurlen, 1930, are reported both from southern Franconia and eastern Bavaria. The only other decapod fossil is the cheliped of an *Enoploclytia* McCoy, 1849 (Röper & Schuster 2003: p. 57, fig. 3). Surprisingly, a raninid crab has been found in the vicinity of Mörnsheim (Fig. 1), within the area in which the famous Upper Jurassic Solnhofen Lithographic Limestones are quarried.

Raninid decapods have never before been recorded from Cretaceous deposits in southern Germany. The stratigraphically oldest record from Germany is an undetermined raninid found in a glacial flint boulder of supposed Danian age in northern Germany (Gripp 1969; Kümmel 1972). Other raninids have been described from the Upper Eocene of Helmstedt and Handorf, Lower Saxony (Förster & Mundlos 1982), and from the Oligocene of Bünde, Westfalia (Münster 1940). Specimens of *Lophoranina* from the alpine Eocene of southern Bavaria are much more abundant (Schafhäutl 1863).

In 1984, a specimen of a raninid crab said to come from southern Franconia was acquired by M. Wulf and subsequently was shown to the late R. Förster from Munich. The latter studied the specimen, but he hesitated to publish a description of the specimen because he was unable to identify the provenance of the specimen. He also showed a plaster cast of the specimen (Munich collection no. 1988 III 135) to the late Wienberg-Rasmussen because it is labelled with the invalid name "*Acanthoranina kuemmeli* Wienberg-Rasmussen". This name had been suggested but never formally introduced for the above mentioned unique raninid specimen discovered in an erratic boulder of supposed Danian age (Gripp 1969; Kümmel 1972). Another specific name noticed by R. Förster on the same label was "*Raninella" baltica* Segerberg.

2. Lithology and Provenance of the Studied Decapod

The matrix of the rock in which the raninid crab is embedded consists of a light grey, silicified, micritic mudstone with many minute pores. These pores represent dissolved sponge spicules. The lithology fits well with rock samples of the

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Lower Turonian "Wellheimer Inoceramenquarzit" from the surroundings of Wellheim, southern Franconia, and especially with the description of Lehner (1933) given for weathered material from this formation. This unit, which may be termed the Wellheim Formation, is widely exposed in the area between Wellheim and the surroundings of Neuburg, mostly restricted to erosional relics in deep karstic depressions. The type locality is a quarry near the little town of Mörnsheim (Fig. 1), situated only a few kilometres from Wellheim, within the area in which the Turonian deposits crop out. Thus, there is no doubt that the raninid specimen originates from this area and does not represent a glacial boulder picked up by someone in northern Germany and later discarded in Franconia.

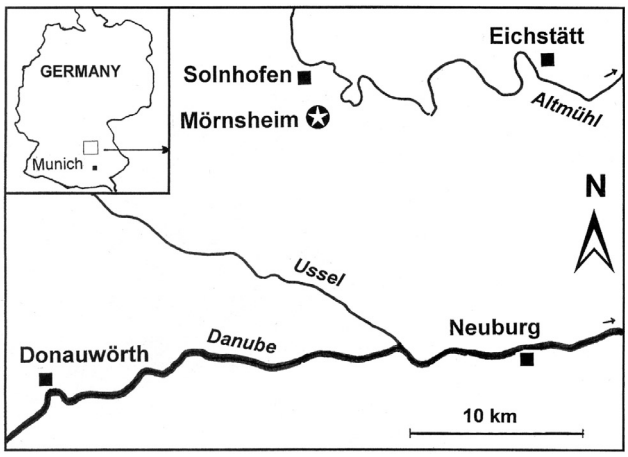

Figure 1. Provenance of the holotype of *Macroacaena franconica* n. sp. in the Upper Cretaceous of southern Franconia, SW Germany.

3. Systematic Palaeontology

Order Decapoda Latreille, 1802

Infraorder Brachyura Latreille, 1802

Section Podotremata Guinot, 1977

Family Raninidae de Haan, 1841

Subfamily Lyreidinae Guinot, 1993

Genus *Macroacaena* Tucker, 1998

Type species: *Lyreidus succedanus* Collins & Wienberg-Rasmussen, 1992.

Other included species:

Macroacaena alseana (Rathbun, 1932), as *Lyreidus*

Macroacaena bispinulata (Collins & Wienberg-Rasmussen, 1992), as *Lyreidus*

Macroacaena chica Schweitzer, Feldmann, Fam, Hessin, Hetrick, Nyborg & Ross, 2003

Macroacaena fudouji (Karasawa, 2000), as *Carinaranina*

Macroacaena lucosiae (Rathbun, 1932), as *Eumorphocorystes?*

Macroacaena marionae (Tucker, 1998), as *Carinaranina*

Macroacaena naselensis (Rathbun, 1926), as *Eumorphocorystes*

Macroacaena rosenkrantzi (Collins & Wienberg-Rasmussen, 1992), as *Lyreidus*

Macroacaena schencki (Rathbun, 1932), as *Eumorphocorystes*

Macroacaena franconica n. sp.

Fig. 2 (cf.-specimen Fig. 3)

cf. 1969 *Pseudoraninella* sp. – Gripp: p. 83, pl. 1, fig. 4.

cf. 1975 *Acanthoranina*. – Kümmel: p. 118, fig. 1.

Holotype: Specimen figured Fig. 2, housed in the collections of the Jura-Museum Eichstätt, JME no. Tu 2003/3, plaster cast of holotype in the collection of the Bayerische Staatssammlung für Paläontologie und Geologie Munich, BSPM no. 1988 III 135.

Derivation of name: *franconica*, coming from Franconia.

Type locality: Surroundings of Mörnsheim.

Type horizon: "Wellheimer Inoceramenquarzit", Wellheim Formation (Lower Turonian, Zone of *Inoceramus (Mytiloides) labiatus*).

Studied material: Holotype, cast of a cf.-specimen from N Germany (Textfig. 3).

Record: S Germany; cf.-specimen from northern Europe (glacial boulder of Danian age from N Germany).

Diagnosis: Species of *Macroacaena* with forwardly-directed anterolateral spines and well-developed globose lobes at fronto-orbital margin, but lacking a median ridge.

Description: The holotype is a well preserved internal cast of a carapace with some fragments of the shell in the posterior part of the carapace. Median ridge lacking. Pereiopods not preserved or hidden by the extremely hard rock matrix.

Measurements: Total length of carapace 28 mm, maximum width of carapace 16.3 mm, width of fronto-orbital margin 9 mm, width of posterior margin about 10.5 mm, length of spines at anterolateral corner 6 mm. The angle subtended between these spines and the anterolateral margins is about 75 degrees. Distance in the longitudinal axis between the tip of rostrum and the spines 6.3 mm. Rostrum as long as outer orbital spines.

Comparisons: *Macroacaena franconica* n. sp. differs from *M. succedana* (Collins & Wienberg-Rasmussen, 1992), *M. rosenkrantzi* (Collins & Wienberg-Rasmussen, 1992), and *M. alseanus* (Rathbun, 1932) in exhibiting a much smaller angle between the lateral spines and the anterolateral margin, and in lacking a longitudinal ridge. Moreover, the fronto-orbital margin of *M. franconica* is broader than in those of the compared species. As in *M. bispinulatus* (Collins & Wienberg-Rasmussen, 1992), *M. franconica* exhibits only a single pair of lateral spines. The poorly preserved *M. bispinulatus* differs from the latter mainly in its more posterior position of the spines. These are the most closely related taxa, morphologically. It is interesting to note that, within the Greenland fauna, another species, referable to a different genus, bears close resemblance to species of *Macroacaena*. *Hemioon eysunesensis* (Collins &

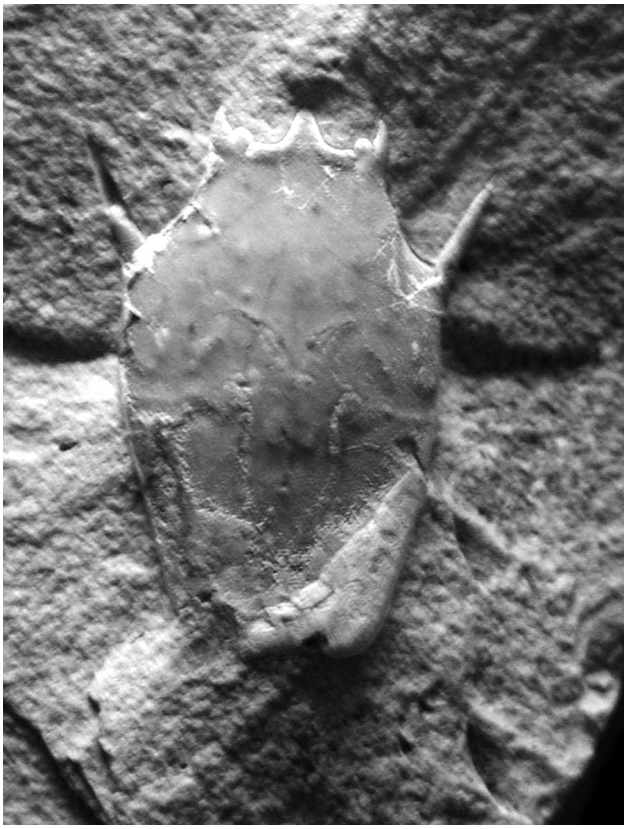

Figure 2. *Macroacaena franconica* n. sp., holotype. Lower Turonian, Mörnsheim, southern Franconia, Germany; ex-situ find, coming from the so called "Wellheimer Inoceramen-Quarzit", Jura-Museum Eichstätt, JME no. Tu 2003/3 (Coll. M. Wulf, Rödelsee). Width of figure 31 mm.

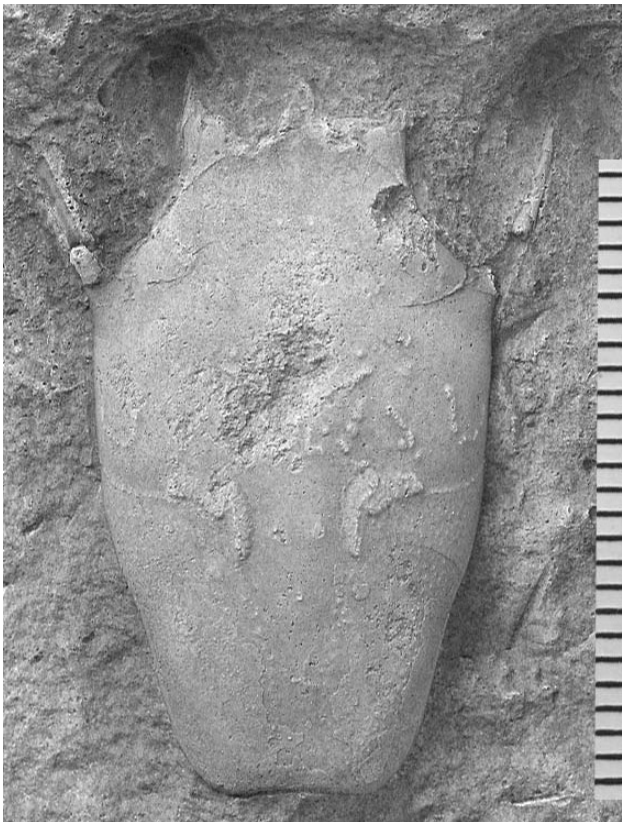

Figure 3. *Macroacaena* cf. *M. franconica* n. sp., cast of specimen figured by Gripp (1969) and Kümmel (1972). From erratic Danian boulder at Travenbrück-Vinzier, northern Germany (photo by courtesy of S. Jakobsen, Kopenhagen). Scale in millimeters.

Wienberg-Rasmussen, 1992) exhibits somewhat shorter spines at the anterolateral corner and shows a furrow on the rostrum, whereas the fronto-orbital areas and the remainder of the carapace appear quite similar to species of *Macroacaena*.

The unnamed raninid recorded by Gripp (1969) and Kümmel (1972) represents another specimen very close to, or even identical with, *Macroacaena franconica* in which the fronto-orbital area is very poorly preserved. The length of the lateral spines is a little greater than those in the holotype but this appears to be intraspecific variation since all other discernible characters are identical. Gripp (1969) compared this specimen, of which only a plaster cast (Fig. 3) was traceable for reinvestigation, with "*Raninella*" *baltica* described by Segerberg (1900, pl. 8, fig. 9) from the Danian deep water coraliferous limestones of Faxe in Denmark. The latter, however, lacks the hypertrophied lateral spines, and, unfortunately, its broad fronto-orbital area is very incompletely preserved. Today "*Raninella*" *baltica* is included in *Raniliformis* Jagt, Collins & Fraaije, 1993 (see Fraaije 2003).

4. Age of the Specimen

According to its provenance from the Wellheim Formation of southern Bavaria, an early Turonian age is suggested for the raninid (Mörs 1991). The early Turonian age is documented by the widespread occurrence of *Inoceramus (Mytiloides) labiatus* Schlotheim, a large benthic bivalve of age-diagnostic value. This species also occurs in the upper part of the Eibrunn and overlying Reinhausen formations of the Regensburg area of eastern Bavaria (Hilbrecht 1986). As a consequence, *Macroacaena franconica* n. sp. represents the oldest known species of the genus.

5. Systematics Position of *Macroacaena franconica* within Lyreid Raninidae

Guinot (1993) re-evaluated the suprageneric subdivisions of the Raninidae and erected three new subfamilies, based primarily upon the structure of the sternum. Among these, the Lyreidinae Guinot, 1993, included two extant genera, *Lyreidus* de Haan, 1841, and *Lysirude* Goeke, 1986. Guinot did not consider fossil forms. Tucker (1998) accepted this classification and added *Macroacaena* Tucker, 1998, to the Lyreidinae. Schweitzer et al. (2000) followed this subfamily placement and commented on the difficulty of distinguishing *Carinaranina* Tucker, 1998, from *Macroacaena*. Subsequently, Schweitzer et al. (2003) restudied *Macroacaena*, placed *Carinaranina* in synonymy with it, added a new species, and provided a suite of measurements and ratios that are useful for distinguishing members of the genus from other genera in the subfamily.

Macroacaena franconica conforms to the definitional bases of the genus, and the relative proportions, as measured on the holotype and most complete specimen, are consistent with those noted by Schweitzer et al. (2003: p. 29) except that the

frontal width/maximum width in *M. franconica* is about 29%, rather than the 22% reported for other species within the genus. Because the other proportions are very close to the averages for the genus; the orbital margin is interrupted by two narrow fissures that define a blunt orbital spine; the anterolateral corner bears a long, anterolaterally-directed spine; and the overall shape is typical of the shape of other species in the genus, the generic placement is certain.

In terms of the morphology of *Macroacaena* spp. relative to other Cretaceous raninids, it must be said that this is an extremely modern-appearing form. Most of the Cretaceous species have been referred to the Notopocorystinae Lörenthey in Lörenthey & Beurlen, 1929 (Haj & Feldmann 2002). Genera within this subfamily tend to be wider, flattened, and coarsely ornamented with strap-like ornamentation or nodes of one sort or another. Typically, they also have distinct groove patterns which are not seen on taxa within the Lyreidinae and, as described by Haj & Feldmann (2002), exhibit a cuticular architecture that may be unique to that subfamily. Thus, *Macroacaena* is one of the first of the streamlined, fusiform organisms that typify the family in modern seas.

Within the subfamily, *Macroacaena* is the only genus that extends into the Mesozoic. The genus ranges from the lower Campanian-Maastrichtian type species, *Macroacaena succedana* (Collins & Wienberg-Rasmussen, 1992), to the Miocene *M. fudouji* (Karasawa, 2000). The other two genera within the Lyreidinae, *Lyreidus* and *Lysirude,* have ranges from Eocene to Recent (Tucker 1998). The inclusion of *Macroacaena franconica* extends the stratigraphic range of the genus back to the Turonian and suggests an origin of the genus in Europe. The pattern of distribution of species within the genus is one of first occurrence in Europe; later Cretaceous records in Greenland (Collins & Wienberg-Rasmussen 1992); and Cenozoic records in the North Pacific region from Oregon, U.S.A., through British Columbia, Canada, and to Japan. This distributional pattern is one that has been referred to as a North Polar pattern by Schweitzer (2001). During the Cretaceous and into the Eocene, this distributional route was a significant avenue of interchange between northern Europe and the north Pacific.

6. Palaeogeographical Implications

Wagner (1963) assumed, after his investigation of a rich siliceous sponge fauna from the Lower Turonian "Kieselweiss" deposits north of Neuburg, that these sediments were deposited in water depths between 100 and 350 meters. This was confirmed by a study of the foraminifers from this formation (Groiss 1964). In analogy to Recent distribution, fossil raninids are thought to be indicative of deep-water settings (Feldmann et al. 1991). Thus, the raninid crab *Macroacaena franconica* provides another strong argument for a deep shelf position of the type locality during the Early Turonian. In eastern Bavaria, in the surroundings of Regensburg, Turonian deposits equivalent to those of the Neuburg-Wellheim area exhibit a more sandy lithology, with sandstones, calcareous sandstones, and marls (Eibrunn and Reinhausen Formations, see Hilbrecht 1986, Röper 1997). From a lithological point of view these deposits represent a shallower environment, situated closer to the coast. According to conventional wisdom (Förster et al. 1983), a direct marine connection between the Cretaceous of northern Germany and southeastern Bavaria via Hesse is strictly excluded, although allochthoneous relics of Cretaceous deposits were recorded far away from the present autochthonous outcrops (Huckriede 1954). The present distribution of deep shelf lithologies like those found in the Wellheim Formation cropping out in southern Franconia indicates a wide northward extension of the Early Turonian gulf in this area.

Toward the west, marine Cretaceous deposits are sparsely recorded as fragments of the fallout of the Ries impact crater. Most likely, the mountains of the nearby Swabian Upper Jurassic had been tectonically uplifted before Turonian times so that the Upper Jurassic is directly overlain by Paleogene local karstic fillings or Oligocene paleosoils and lacustrine deposits.

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Joe S. H. Collins (London) and Thomas Mörs (Stockholm) kindly provided important literature for this study. Gerhard Schairer (Munich) provided rock samples from the Lower Turonian of southern Franconia for comparison. Sten L. Jakobsen (Kopenhagen) submitted a picture of the surviving cast of an important raninid specimen from the Danian for study. Mrs Rotraud Harling (Stuttgart) prepared another photo. The manuscript was critically read by Carrie E. Schweitzer (Kent, Ohio). Our thanks to these individuals.

7. References

Collins, J. S. H. & Wienberg-Rasmussen, H. (1992): Upper Cretaceous-Lower Tertiary decapod crustaceans from West Greenland. – Bulletin Grønlands Geologiske Undersøgelse, **162**: 1-46.

Feldmann, R. M. (1989): *Lyreidus alseanus* Rathbun from the Paleogene of Washington and Oregon, U.S.A. – Annals of the Carnegie Museum, **58**: 61-70.

Feldmann, R. M. (1992): The genus *Lyreidus* de Haan, 1839 (Crustacea, Decapoda, Raninidae): Systematics and biogeography. – Journal of Paleontology, **66**: 943-957.

Feldmann, R. M., Tucker, A. B. & Berglund, R. E. (1991): Paleobathymetry of decapod crustaceans, Washington. – National Geographic Research and Exploration, **7**: 352-363.

Feldmann, R. M. & Zinsmeister, W. J. (1984): New fossil crabs (Decapoda: Brachyura) from the La Meseta Formation (Eocene) of Antarctica: paleogeographic and bigeographic implications. – Journal of Paleontology, **58**: 1046-1061.

Förster, R., Meyer, R. & Risch, H. (1983): Ammoniten und planktonische Foraminiferen aus den Eibrunner Mergeln (Regensburger Kreide, Nordostbayern). – Zitteliana, **10**: 123-141.

Förster, R. & Mundlos, R. (1982): Krebse aus dem Alttertiär von Helmstedt und Handorf (Niedersachsen). – Palaeontographica, A **179**: 148-184.

Fraaije, R. H. B. (2003): Evolution of reef-associated decapod crustaceans through time, with particular reference to the Maastrichtian type area. – Contributions to Zoology, **72**: 119-130.

Goeke, G. D. (1985): Decapod Crustacea: Raninidae. – Mémoires de la Muséum Nationale d'Histoire naturelle, série A, Zoologie, **133**: 205-228.

Gripp, K. (1969): Fossilien aus Norddeutschland. – Meyniana, **19**: 79-89.

Groiss, J. T. (1964): Eine Mikrofauna aus der albüberdeckenden Kreide der südlichen Frankenalb. – Erlanger geologische Abhandlungen, **53**: 1-23.

Guinot, D. (1993): Donnée nouvelles sur les Raninoidea de Haan, 1841 (Crustacea Decapoda Brachyura Podotremata). – Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences (Paris), Series III, **316**: 1324-1331.

Haj, A. E. & Feldmann, R. M. (2002): Functional morphology and taxonomic significance of a novel cuticular structure in Cretaceous raninid crabs (Decapoda: Brachyura: Raninidae). – Journal of Paleontology, **76**: 472-485.

Hilbrecht, H. (1986): Die Turon-Basis im Regensburger Raum: Inoceramen, Foraminiferen und „events" der Eibrunner Mergel bei Bad Abbach. – Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, **172**: 71-82.

Huckriede, R. (1954): Über umgelagerte marine Kreide in Hessen. – Neues Jahrbuch für Geologie und Paläontologie, Monatshefte, **1954**: 331-361.

Kümmel, R. (1972); Seltener Crustaceenfund aus dem Danium. – Der Geschiebesammler, **6**: 188-122.

Lehner, L. (1933): Beobachtungen an Cenomanrelikten der südlichen Frankenalb. Studien über die fränkische albüberdeckende Kreide. II. – Centralblatt für Geologie, Mineralogie und Paläontologie, B **8**: 458-470.

Lehner, L. (1937): Fauna und Flora der fränkischen albüberdeckenden Kreide. II. Fauna. 2. Teil und Flora. – Palaeontographica, A **87**: 158-230.

Mörs, T. (1991): Zur Petrographie, Sedimentologie und Stratigraphie der Wellheimer Kreide (Südliche Frankenalb, Bayern). – Archaeopteryx, **9**: 73-81.

Münster, G. Graf zu (1840): Ueber ein neues fossiles Brachyuren-Genus. – Beiträge zur Petrefacten-Kunde, **3**: 23-25.

Röper, M. (1997): Eine neue Fundsituation in den Eibrunner Mergeln von Bad Abbach (Regensburger Oberkreide/Oberes Cenomanium bis Unteres Turonium). – Acta Albertina Ratisbonensia, **50**: 65-76.

Röper, M. & Schuster, A. (2003): Fossile Schätze aus Jura und Kreide im Kelheimer Raum. – Archäologisches Museum der Stadt Kelheim, Museumsheft 7; Kelheim (Archäologisches Museum), 76 pp.

Schafhäutl, K. E. (1863): Südbayerns Lethaea geognostica. Der Kressenberg und die südlich von ihm gelegenen Hochalpen geognostisch betrachtet in ihren Petrefakten; Leipzig (Voss), 487 pp.

Schweitzer, C. E. (2001): Paleobiogeography of Cretaceous and Tertiary decapod crustaceans of the north Pacific Ocean. – Journal of Paleontology, **75**: 808-826.

Schweitzer, C. E., Feldmann, R. M., Tucker, A. B. & Berglund, R. E. (2000): Eocene decapod crustaceans from Pulali Point, Washington. – Annals of the Carnegie Museum, **69**: 23-67.

Schweitzer, C. E., Feldmann, R. M., Fam, J., Hessin, W. A., Hetrick, S. W., Nyborg, T. G. & Ross, R. L. M. (2003): Cretaceous and Eocene Decapod Crustaceans from Southern Vancouver Island, British Columbia, Canada; Ottawa (NRC Research Press), 66 pp.

Segerberg, K. O. (1900): De anomura och brachyura decapoderna inom Skandinaviens Yngra Krita. – Geologiska Föreningens Stockholm Förhandlingar, **22**: 347-490.

Tucker, A. B. (1998): Systematics of the Raninidae (Crustacea: Decapoda: Brachyura), with accounts of three new genera and two new species. – Proceedings of the Biological Society of Washington, **111**: 320-371.

Wagner, W. (1963): Die Schwammfauna der Oberkreide von Neuburg (Bayern). – Palaeontographica, A **122**: 166-250.