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A new species of Tumidocarcinidae (Decapoda, Carpilioidea) from the Kambühel Formation (Paleocene) of Austria

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(With 3 figures)

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Abstract

Titanocarcinus kambuehelensis new species is described from the Paleocene Kambühel Formation of Austria. *Titanocarcinus* ranges from the Cretaceous through the K/T mass extinction into the Eocene. This species is part of a reef fauna, which is one of several similar Paleocene occurrences in Northern and Central Europe. The new species is relatively small for the genus, and only the dorsal carapace is known.

Keywords: *Titanocarcinus*, Decapoda, Kambühel, Paleocene, Austria, New Taxa

Introduction

Decapod crustaceans, especially the brachyurans and anomurans, are very abundant and diverse in shallow marine environments. In high energy, shallow environments their remains are rarely preserved in contrast to the remains of the shelly fauna. Upon death or molting, decapod remains are extremely fragile, mostly because part of the skeletal material is organic (Schäfer 1951). Thus, decapod remains that are exposed on the sea floor are subject to fragmentation (Bishop 1986) and scavenging (Tshudy et al. 1989). However, coral reefs are among the environments where decapods are more likely to be preserved in cavities between and within coral colonies (Müller 2004), which serve to increase the probability of their preservation. Because of the patchy nature of such sites, collection of decapods in such rocks must be concentrated on parts of the host rock that were deposited in low energy shelters or on cavities between and within coral colonies. One of these sites, the Palaeocene Kambühel locality in the Eastern Alps of Austria, has yielded a rich decapod fauna.

The Kambühel Formation is a little-studied Paleocene formation southwest of Wien (fig. 1) (Müller 2004) that is interpreted to represent a fringing reef. The unit is of

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Fig. 1. Map of the eastern portion of Austria, showing the location of the Kambühel Formation.

interest because of the well-preserved decapod fauna associated with it (MÜLLER 2004). Comparable decapod assemblages found in other localities in Europe usually consist of galatheids, Xanthidae sensu lato, and pagurids (MÜLLER, 2004). The fossils are typically small (a few millimeters to a few centimeters across), consist almost entirely of dorsal carapaces, and are well preserved (MÜLLER 2004); no articulated remains are known. The Kambühel Formation is further important because it was deposited in the Thanetian (late Paleocene) (TRAGELEHN 1994), when coralgal framework reefs were beginning to once again become common following the K/T mass extinction (PERRIN 2002). The age relationships of the unit were based upon microfauna and microflora (PLÖCHINGER 1967). Danian reefs from the Iberian Peninsula (AGUIRRE et al. 2007) and Italy (VECSEI et al. 1997) have been found, but these appear to be rare and no decapods have been reported from these sites. Therefore, the Kambühel Formation should elucidate the recovery of decapods from the end-Cretaceous mass extinction.

Other Paleocene decapod faunas can be found in Europe, most notably in Denmark and Sweden. These faunas are comprised of 15 genera, of which 10 made their first appearance in the Cretaceous (COLLINS & JAKOBSEN 1994). However, the deposits of Denmark and Sweden were deposited in the Danian (early Paleocene) in either bryozoan dominated or coral/bryozoan banks (COLLINS & JAKOBSEN 1994), whereas the decapod-bearing member of the Kambühel Formation was deposited in the Danian (TRAGELEHN 1994) in a coralgal reef environment (MÜLLER 2004; TRAGELEHN 1994). These differences makes comparisons between these faunas difficult.

The purpose of this paper is to describe *Titanocarcinus kambuehelensis*, a new species of decapod, based upon some of the best-preserved specimens known from the decapod fauna of the Kambühel Formation. It represents the first new species to be described from the Kambühel decapod fauna. Previously, the known examples of *Titanocarcinus* from the Paleocene have been from Denmark (SCHWEITZER et al. 2007), and a partial specimen from Poland (FRAAYE 1994). *T. reisi* BÖHM, 1891 was reported from Austria (FÖRSTER 1970), but SCHWEITZER et al. (2007) place this species in Hepatidae; thus, *T. kambuehelensis* represents a geographic range extension for Paleocene members of the family Titanocarcinus.

Systematic Paleontology

Order Decapoda LATREILLE, 1802

Superfamily Carpilioidea ORTMANN, 1893

Family Tumidocarcinidae SCHWEITZER, 2005

Genus *Titanocarcinus* A. MILNE-EDWARDS, 1864

T y p e s p e c i e s : *Titanocarcinus serratifons* A. MILNE-EDWARDS, 1864.

I n c l u d e d s p e c i e s : This genus was recently re-evaluated, and a comprehensive list of species can be found in SCHWEITZER et al. (2007).

R e m a r k s : There is some confusion regarding the placement of family Tumidocarcinidae. The family should properly be placed within Carpilioidea, as was done by KARASAWA SCHWEITZER (2006). SCHWEITZER (2007) places Tumidocarcinidae in the superfamily Xanthoidea MACLAY, 1838. This is not an incorrect placement on SCHWEITZER'S part, but rather a consequence of the timing of the publications.

Titanocarcinus kambuehelensis nov. spec.
(figs 2, 3)

D i a g n o s i s : Similar to *Titanocarcinus briarti* FORIR, 1887. Groove separating epibranchial and metagastric regions from mesobranchial, metabranchial, and cardiac region deep, straight; grooves on sides of cardiac regions shallow, almost indistinct. Separation between metagastric and cardiac regions nearly equal, shallow. Fifth anterolateral spine, including outer orbital spine, smallest.

E t y m o l o g y : The species name is derived from the Kambühel Formation, where the specimens were found.

T y p e s : The holotype is one large specimen, specimen number NHMW 2007z0166/0001, comprising most of the dorsal carapace (fig. 2). Eleven smaller paratypes, NHMW 2007z0166/0002 to NHMW 2007z0166/0012, show various portions of the dorsal carapace. All are deposited in the collection of the Natural History Museum Vienna.

O c c u r r e n c e : Kambühel Formation, latitude N47°44'52.9'' longitude E16°02'0.94'', 3.5 km north of Ternitz, Austria.

D e s c r i p t i o n : Carapace small, measurements of holotype as follows: maximum length 8 mm, maximum width 9.67 mm, frontal width 2.24 mm, fronto-orbital width 6.48 mm (67 % of total width). Maximum carapace length/maximum carapace width ratio 0.83. Carapace nearly flat transversely; gently arched longitudinally, reaching maximum height in protogastric region.

Front weakly sulcate with shallow axial sulcus and tiny granules around axial sulcus; front extends well beyond orbits, lateral angle nearly straight with axial notch. Orbits shallow; upper margins smooth, with two closed fissures (figs 3B, 3D, and 3F); blunt

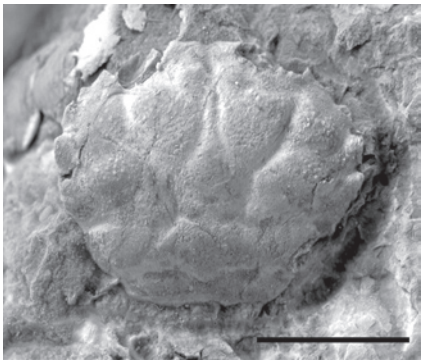

Fig. 2. *Titanocarcinus kambuehelensis* nov. spec. holotype (NHMW 2007z0166/0001). Dorsal view. Scale bar equals 5 mm.

protrusion present between orbital fissues. Anterolateral margin with five triangular spines (including outer orbital spine), increasing in size posteriorly to fourth spine; fifth spine somewhat smaller than other spines; spines directed slightly dorsally and anterolaterally, becoming less anteriorly-directed posteriorly. Posterolateral margin smooth, straight, except for small concavity near metabranchial region; obtuse angle between posterolateral margin and posterior margin. Posterior margin smooth, straight.

Regions well-defined, elevated, usually defined by grooves, otherwise present as raised areas. Frontal region with transverse crest paralleling frontal margin, splitting axially by axial sulcus. Mesogastric region with long, narrow anterior region and bulbous posterior region. Metagastric region semicircular, concave anteriorly; separated from mesogastric region by shallow groove. Cardiac region weakly developed; pentagonal, with compressed anterior portion, directed posteriorly. Intestinal region not defined. Epigastric region small, protruding from extreme anterior axial portion of, and not clearly separated from, protogastric region. Protogastric region triangular, separated from mesogastric region by shallow groove and from hepatic region by deep groove (= circumgastric groove). Hepatic region trapezoidal, bounded anteriorly by circumgastric groove, separated posteriorly from epibranchial region by cervical groove. Epibranchial region relatively large, elliptical, bulbous, separated from mesobranchial region by shallow groove posteriorly, cervical groove anteriorly. Mesobranchial region small, bulbous; separated from epibranchial region by a shallow groove and from metabranchial region by very shallow groove. Metabranchial region slightly raised, transversely elongate, with very small bulge near center of region. Subhepatic region highly eroded and mostly covered with rock; smooth. Entire dorsal carapace granular.

Only dorsal carapace and a small part of subhepatic region exposed. Sternum, abdomen, and pereiopods missing. Some specimens show evidence of partial removal of cuticle; small-scale features may not be present on exposed surface of cuticle. Molds show evidence of small granules on anterior portion of carapace.

D i s c u s s i o n : This species is remarkably similar to *Titanocarcinus briarti* from the Maastrichtian of the Netherlands. However, unlike *T. briarti*, the groove separating the cardiac region from the metagastric region in *T. kambuehelensis* is shallow and weakly defined. Also, the posterior groove (separating the epibranchial region from the mesogastric and urogastric regions) (Schweitzer et al. 2007) is straight in this species,

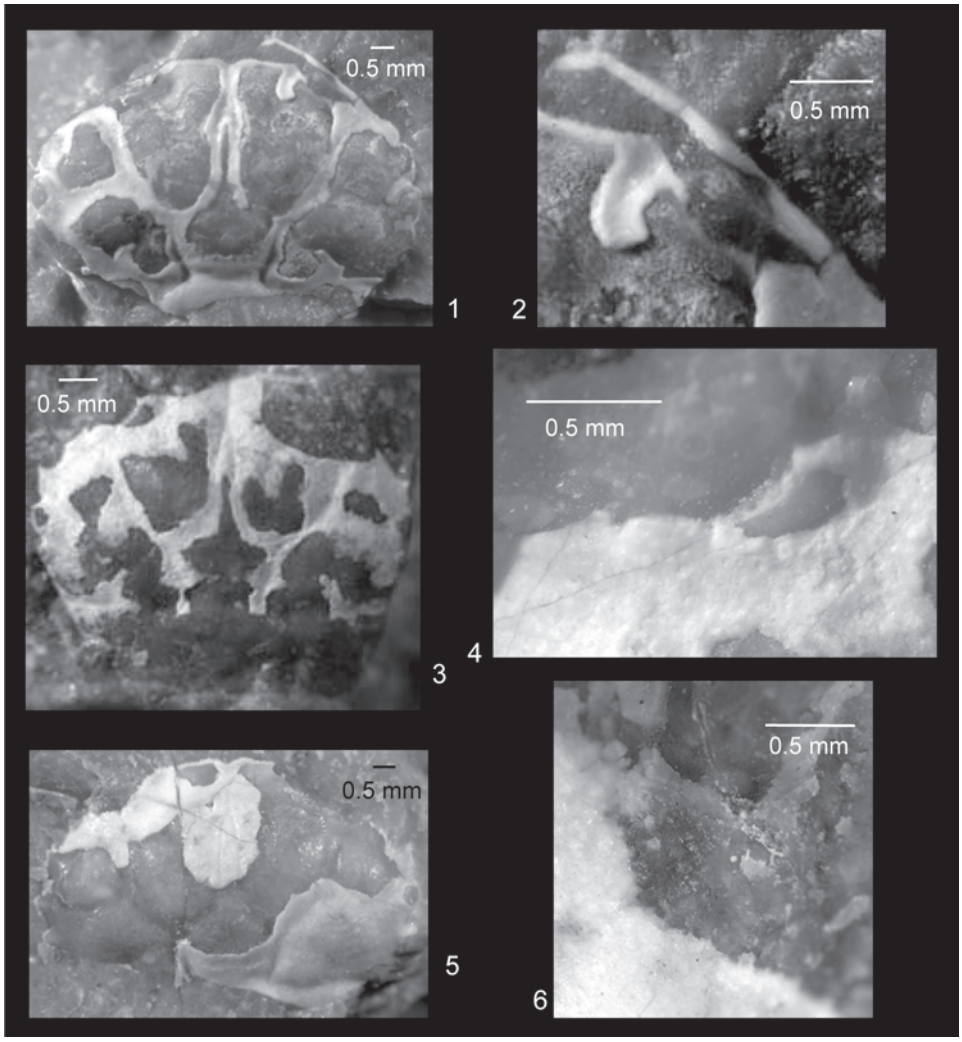

Fig. 3. *Titanocarcinus kambuehelensis* nov. spec. 1. NHMW 2007z0166/0002, complete carapace, dorsal view. Note the lack of cuticle on raised portions of specimen. 2, NHMW 2007z0166/0002, close-up of orbit, dorsal view in same orientation as A. Note the two orbital sutures. Extension of cuticle above specimen unidentified. 3, NHMW 2007z0166/0009, whole specimen, dorsal view. Note again the lack of cuticle on raised portions of specimen. 4, NHMW 2007z0166/0009, close-up of orbit, dorsal view in same orientation as C. Note the two orbital sutures. 5, NHMW 2007z0166/0011, whole specimen, dorsal view. Note that much of the cuticle is missing, though in a different pattern than in the other carapaces shown. 6, NHMW 2007z0166/0011, close-up of orbit, dorsal view rotated 90 degrees clockwise from the orientation of 5. Note the two orbital sutures, which are weak in this case and partially obscured by recrystallization. Scale bars equals 0.5 mm.

and the grooves on either side of the cardiac region are very shallow. In *T. briarti*, the cardiac region is surrounded by distinct grooves (SCHWEITZER et al. 2007). Finally, the

fifth spine in *T. kambuehelensis* is much smaller than the other spines on the anterolateral margin.

These similarities can be explained by the similarities in environment between the locality for *Titanocarcinus briarti* and *T. kambuehelensis*. *T. briarti* is documented from the Maastrichtian type area, a shallow environment dominated by alternating hardgrounds and relief infillings which experienced strong storm activity (Fraaije 2003). Bioherms were relatively small (Fraaije 2003). The Kambühel Formation was a geographically constrained shallow reef environment (Tragelehn 1996), and though no storm activity has presently been documented this may be attributed to the restricted geographic range. As both crabs evolved in very similar environments, it is reasonable that they be very similar.

Titanocarcinus kambuehelensis differs from *Titanocarcinus serratifrons* Milne-Edwards, 1864, from the Late Cretaceous of Belgium because the anterolateral spines of *T. kambuehelensis* are not granular, and *T. kambuehelensis* is strongly inflated anteriorly. Unlike *T. faxeensis* von Fischer-Benzon, 1866 and *T. subellipticus* Segerberg, 1900, both from the Danian of Denmark, *T. kambuehelensis* does not have well defined orbital spines. The fourth and fifth anterolateral spines of *T. raulinianus* Milne-Edwards, 1864, from the Eocene of France, Hungary, Italy (Schweitzer et al. 2007), and Austria (Gross 1981) are directed more anteriorly than those of *T. kambuehelensis*. *Titanocarcinus decor* Schweitzer et al., 2007, from the Lower Eocene of Spain has large, pearly tubercles on the anterior carapace regions, whereas *T. kambuehelensis* has much finer ornamentation and is more strongly convex longitudinally.

Titanocarcinus kambuehelensis lacks the diagnostic lateral extensions of the cardiac region which are present in the genus *Lobonotus* Milne-Edwards, 1864. The fifth anterolateral spine of *T. kambuehelensis* distinguishes this species from *Nitotacarcinus* Schweitzer et al., 2007, which has three spines and a swelling on the anterolateral margins. *Titanocarcinus kambuehelensis* also lacks the spines on the front, orbits, and dorsal carapace which are present on species of *Lathahypossia* Schweitzer et al., 2007.

The preservation of these specimens is typical of decapods in the Kambühel fauna. They are small, disarticulated, and only the carapace is visible. Detail is well-preserved, but the exocuticle is missing; the rock in which each fossil was found was split open to find the fossil, and a portion of the cuticle remained on each part of the rock. This can be seen particularly well in figures 3.1, 3.3, and 3.5, which show several *Titanocarcinus kambuehelensis* carapaces with missing cuticle. The missing cuticle remained on the portion of rock that split away from the portion shown in the figures. Additionally, the rock around the fossils was recrystalized. Therefore, details may be missing from this species, particularly if those details were only on the exocuticle. For example, any evidence of epibionts is missing.

I m p l i c a t i o n s : This specimen demonstrates how conservative the genus Titanocarcinus is. There is little change in morphology across the K/T boundary. In fact, the most striking change is that the Eocene species *T. rauliniaus* and the Danian species *T. subellipticus* both have noticeably smaller cardiac regions than the other members of this genus. There is also a slight difference in morphology based on geography: species from the North Sea tend to have more uniform anterolateral spines than those from the Tethys Sea. However, given the limited number of species in this genus and the limited

number of localities at which these species are found, hypothesizing about the cause of these slight differences is premature.

Conclusions

Titanocarcinus kambuehelensis, identifiable by the unique pattern of grooves and relatively short fifth anterolateral spine, represents the first new species of decapod to be named from the Kambühel Formation of Austria. This specimen is interesting, as it shows the remarkable lack of alteration to the genus *Titanocarcinus* across the K/T boundary. There is a slight geographic signal. In general, *Titanocarcinus* shows very little morphological response despite major environmental perturbations.

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