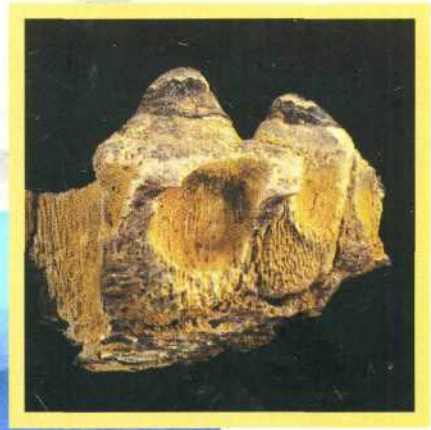
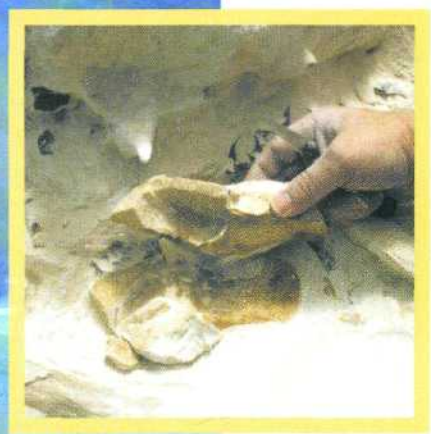
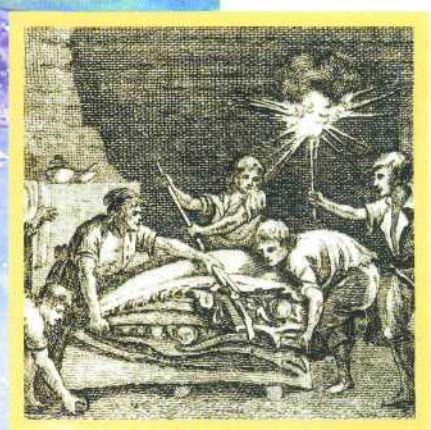
On Maastricht Mosasaurs

Anne S. Schulp







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On Maastricht Mosasaurs

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door

Anne Sytze Schulp

geboren te Sneek

promotor: prof.dr. D. Kroon

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Part III - Palaeobiology

Chapter 4 - First record of the Late Cretaceous durophagous mosasaur *Carinodens belgicus* (Reptilia, Squamata) from Volgograd Region (Russia) and Crimea (Ukraine)

Anne S. Schulp, Alexander O. Averianov, Alexander A. Yarkov, FHipA. Trikolidi & John W.MJagt

Introduction

The enigmatic durophagous Late Cretaceous (A/laastrichtian) mosasaurid genus, *Carinodens* (Squamata), is shown to have had a much wider distribution than previously thought. To date, merely two dentaries of the type and sole species of the genus, *C. belgicus* (= *C fraasi)* are available: the holotype and a recently collected fragment, both from the type area of the Maastrichtian Stage (Maastricht area, SE Netherlands). In addition, a few dozen isolated teeth and tooth crowns are known from the same area, but so far only a handful of isolated tooth crowns have been recorded from elsewhere. We present two new records of the genus *Carinodens* from the Upper Cretaceous (Maastrichtian) of Russia and the Ukraine (Figure 1), and the distribution of this unusual mosasaur is briefly discussed.

Systematic palaeontology

SQUAMATA Oppel, 1811
MOSASAUROIDEA Gervais, 1853 (nom. transl. Camp, 1923)
MOSASAURIDAE Gervais, 1853
MOSASAURINAE Gervais, 1853 (nom. transl. Williston, 1897)
GLOBIDENSINI Russell, 1967 (see also Bell, 1997)
CARINODENS Thurmond, 1969
CARINODENSBELGICUS(Woodward,1891)
(Figure 2)

Material

Two isolated tooth crowns, ZIN PH 1/61 (Fig. 2A-C) and ZIN PH 2/61 (Fig. 2D-F).

Taxonomy

The taxonomic status of the genus *Carinodens* has changed considerably over the years; reference is made to Chapter 3 and references therein for more details. Kuypers et al. (1998)

Figure 1. *Map of western Russia and the Ukraine, showing localities in Crimea (A) and Volgograd Region (B) which yielded the present tooth crowns* o/Xarinodens belgicus.

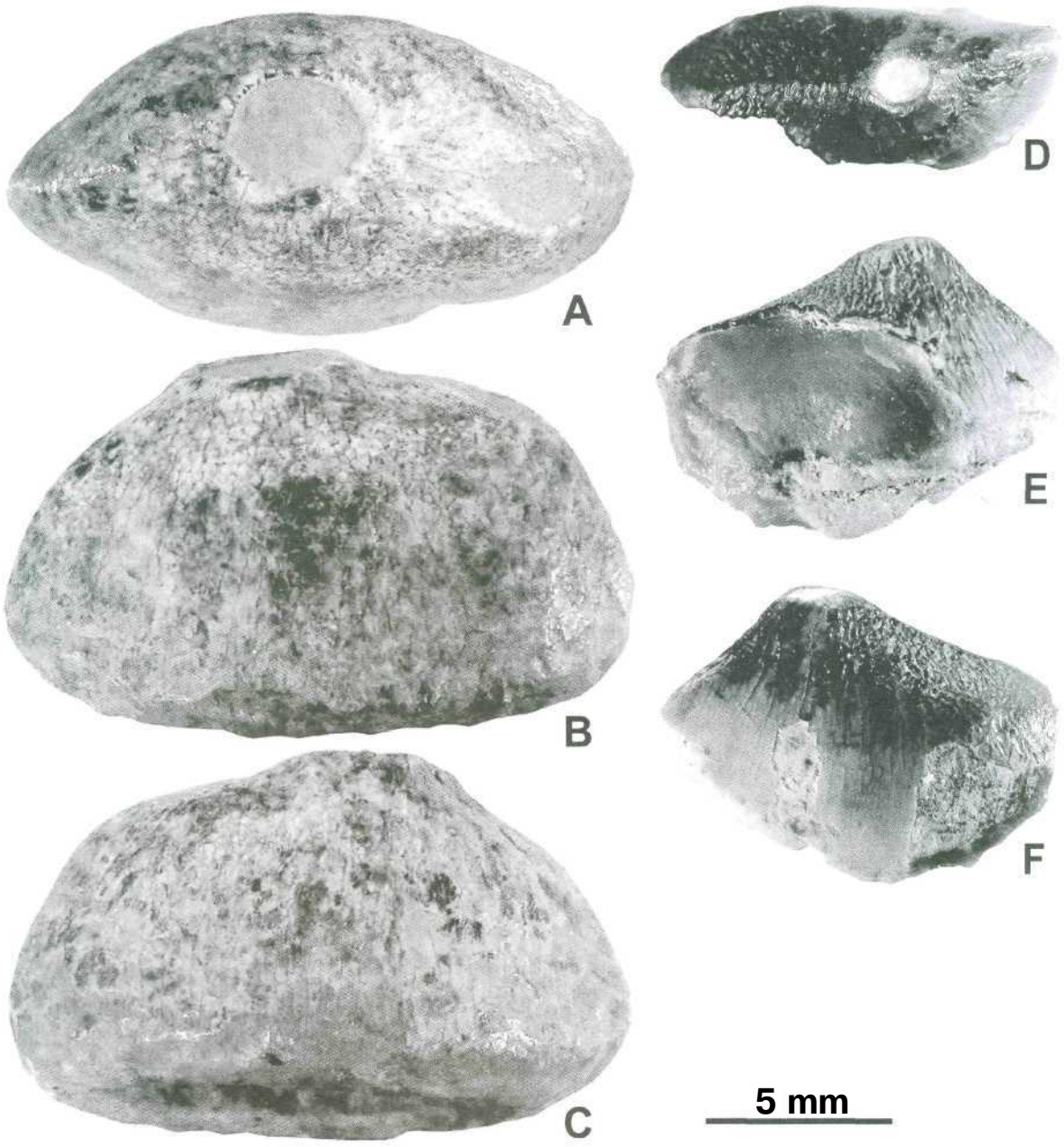

Figure 2. *New material of the durophagous mosasaur,* Carinodens belgicus. A-C: *ZIN PH 1/61, from Trudolyubovka, Crimea (Ukraine), in occlusal (A) and lateral/lingual view (B, C);* D-F: *ZIN PH 2/61, from the Balykleika River site, Volgograd Region (Russia), in occlusal (D) and lateral/lingual view (E, F).*

synonymised *Carinodens fraasi*(Dollo, 1913) with C. *belgicus* (Woodward, 1891), the latter having priority.

Locality and stratigraphy

ZIN PH 1/61, collected by one of us (F.A.T.), comes from Bakla Hill near the village of Trudolyubovka (45°22'N, 34°37'E) in the district of Bakhchisarai, Crimea, Republic of Ukraine. The source is a glauconitic sandstone of Danian (early Paleocene) age, overlying Maastrichtian (Late Cretaceous) sandstone. Associated vertebrate taxa include shark and ray *(Squatina* sp. or *Cretorectolobus* sp., *Carcharias* sp., *Cretolamna appendiculata, Squalicoraxcf. kaupi, Pseudocoraxaffinis* and *Rhombodus* cf. *binkhorsti)* and mosasaur teeth, including those of cf. *Liodon* sp. with serrated carinae, misinterpreted in a previous paper (Averianov & Trikolidi, 2000) as teeth of a ziphodont crocodile (cf. *Doratodon* sp.; misidentification first noted by one of us, A.A.Y.). We consider these vertebrate remains to have possibly been reworked from underlying Maastrichtian strata. The village of Trudolyubovka has been the base station for for geological field practice of students from St Petersburg University for more than fifty years, and the geology of the region is well known (Prozorovskii, 2002). In spite of this, remains of vertebrates have proved to be quite rare in the Cretaceous and Paleogene deposits in the area (e.g., Gorbach, 1967; Novikov et al., 1987). The most significant record from Crimea is the hind limb of the

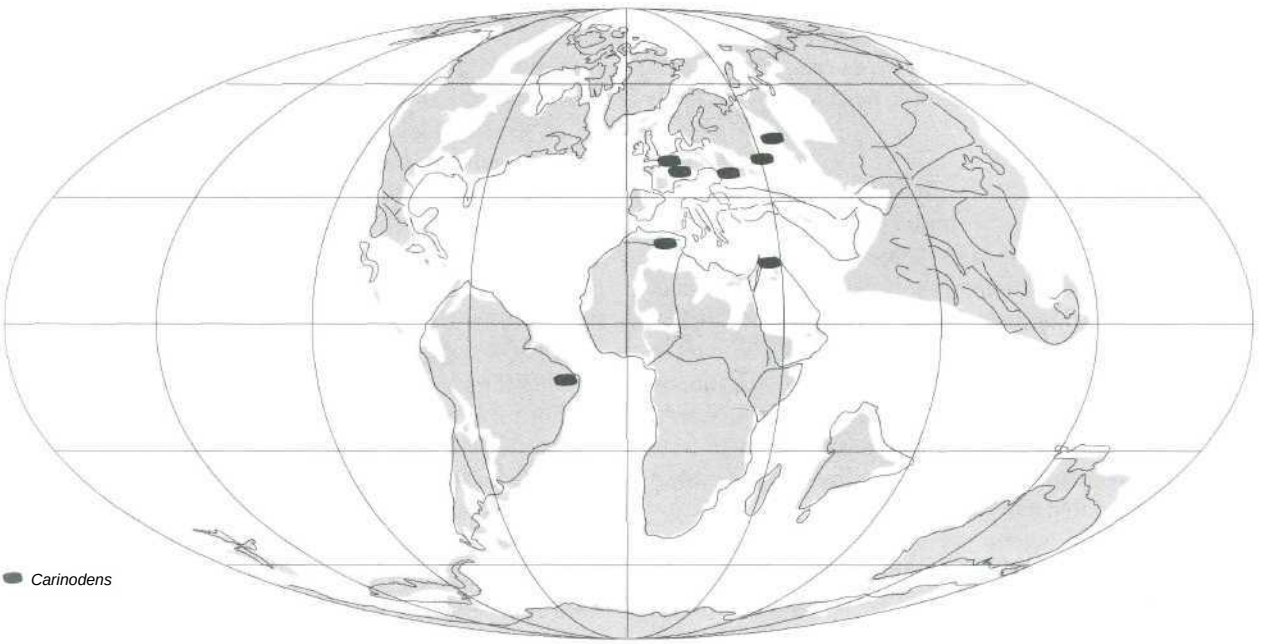

Fig. 3. *Distribution* o/Tarinodens; *Maastrichtian palaeogeography after Patzkowsky et al. (1991).*

ornithopod dinosaur, *'Orthomerus' weberae* Riabinin, 1945, collected in 1934 by G.F. Weber from upper Maastrichtian deposits at Besh-Kosh Hill, near Bakhchisarai (Riabinin, 1945)-

ZIN PH 2/61, collected by one of us (A.A.Y.), is from the Balykleika River site in Volgogradskaya oblast' (Volgograd Region, Russia; approximately 49°22' N and 44°58' E). The specimen comes from a phosphoritic bone bed within the Maastrichtian Bereza Beds; this has yielded remains of phosphatised wood, bivalves, coleoid cephalopods, sharks, chimaerids, teleosts, mosasaurs and turtles (Yarkov, 2000; Popov & Yarkov, 2001). From a nearby locality, Rasstrigin 1, exposing the same beds, remains of a sturgeon *CAcipenser' gigantissimus),* a chimaerid *(Edaphodon eolucifer)* and a large turtle (Cryptodira *incertae sedis)* have been described (Nessov, 1997; Popov & Yarkov, 2001; Averianov & Yarkov, 2004).

Description

ZIN PH 1/61 (Fig. 2A-C) is incomplete; crown length, as preserved, is 10.9 mm, width 4.6 mm and height 8.3 mm. The enamel cover is only partially preserved. The carina, still clearly visible, can be traced all over the tooth in occlusal view; the central occlusal surface is worn, exposing the underlying dentine. The thick enamel is wrinkled, both in lateral and in lingual view, part of the enamel cover is missing, showing the increase in thickness of the enamel layer along the crown towards the apex. In lateral view, the tooth crown is slightly asymmetrical, with the carinae on both shoulders concave in profile.

ZIN PH 2/61 (Fig. 2D-F) is larger and more massive; crown length is 16.7 mm, width 8.2 mm and height 10.4 mm. The enamel cover, although abraded, is preserved. Only the posterior portion of the carina can be traced, the anterior one having worn down for the greater part; in addition to the highly abraded central occlusal surface (exposing the underlying dentine), along the anterior part of the carina a second wear facet developed. The shoulders of the crown (in lateral view) are convex, to become slightly concave just near the apex. Although this specimen is less well preserved than ZIN PH 1/61, the wrinkles on the enamel surface are still visible.

Systematic attribution

Both specimens can confidently be assigned to *Carinodens belgicus,* representing posteriormost teeth. Teeth of *Carinodens* in this position are characteristically bulbous in lateral view, blunt, labio-lingually flattened and antero-distally elongate. Newly erupted teeth have one apical cusp, which is immediately subjected to wear, soon exposing the underlying dentine, and two relatively minor accessory cusps, which only become abraded once the tooth actually occludes with the opposite element or is subjected to a longer or more extensive period of wear. The enamel is wrinkled, like in most other globidensine mosasaurs (Bell, 1997). The enamel cover is thick, about 0.5 mm in ZIN PH 1/61. The variation in size and aspect ratio falls well within the range observed in material in the NHMM collections (compare Kuypers et al., 1998; Chapters 3 and 8).

Despite the fact that there is a relatively high degree of heterodonty in *Carinodens,* it remains difficult to assign these two specimens to precise tooth positions within the dentary or maxilla -also because only two dentary fragments are known to date (Chapter 3). Although we may assume that the maxillary dentition to some degree represents a mirror image of that of the dentary, and although the asymmetrical placement of the central occlusal surface and the carinae would theoretically allow to assign isolated teeth to left or right dentaries or maxillae, the variation in the two available dentary specimens is already too wide to hazard a guess on the original position of these. Regardless of that, when comparingthe specimens described here with the holotype,

and taking particular attention to the outline in lateral view, we can assume that both ZIN PH 1/61 and ZIN PH 2/61 occupied one of the posteriormost positions in the tooth row.

Distribution

The present specimens represent the first record of *Carinodens* from Russia and Crimea (Ukraine). So far, *Carinodens* has been known from isolated teeth and tooth crowns and two dentaries from the Netherlands and Belgium (Dollo, 1913; Kuypers et al., 1998; Chapter 3), isolated tooth crowns from Brazil (Price, 1957), Morocco (Arambourg, 1952; Bardet et al., 2005) and Bulgaria (Tzankov, 1939). An additional occurrence of a *Carinodens-ilke* mosasaur from Jordan was mentioned by Mustafa & Zalmout (2001), again based on an isolated tooth only.

Although virtually known by isolated teeth only, the distribution map (Fig. 3) shows that towards the end of the Cretaceous, *Carinodens* occupied a wide geographic range, both palaeolongitudinally (Brazil to Russia), as well as in terms of palaeolatitude: from sub-equatorial Brazil all the way up to the Forties of the Maastricht area, the northernmost occurrence. So far, finds from the Maastricht area have proved the richest.

Mulder (1999) extensively discussed transatlantic similarities between the type Maastrichtian and mosasaur faunas from New Jersey (USA), noting in particular the presence *of Mosasaurus* and *Plioplatecarpus* on both sides of the Atlantic. Interestingly, *Carinodens* has not yet been reported from North America. Was the northern Atlantic too wide or too cold to cross for this small mosasaur? Or could a lack of suitable environments along North American shores be an explanation? The possible diet of *Carinodens* has been the subject of speculation and research ever since its initial description almost a century ago (Dollo, 1913; Russell, 1975; Lingham-Soliar, 1999; Chapters 3 and 8). A better knowledge of the dietary specialisations of *Carinodens* might help improve our understanding of the distribution of this taxon in the fossil record. Biomechanical experiments (Chapter 8) suggest that the dentition of *Carinodens* was suitable for processing a wide range of food items, with handling relatively small, hard-shelled food items such as molluscs and arthropods probably being the stronghold of *Carinodens,* so perhaps the lack of suitable food sources prevented this specialised mosasaur from expanding its range to North America.

Conclusion

Two new occurrences of the mosasaur *Carinodens* are recorded, one from Russia (Volgograd Region), the other from Crimea (Ukraine). *Carinodens* was a highly specialised, durophagous mosasaur which showed a wide distribution towards the end of the Cretaceous. Although this particular mosasaur is relatively rare, and known almost exclusively from isolated teeth and tooth crowns, the new occurrences show that *Carinodens* was even more widespread than previously thought.

Colophon

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