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Caviziphius altirostris, a new beaked whale from the Miocene southern North Sea basin

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An odontocete cranium from Miocene deposits in northern Belgium is examined and referred to *Caviziphius altirostris*, a new genus and species of beaked whale. In the general architecture of its vertex and closed mesorostral canal, *Caviziphius* resembles the fossil genera *Ziphirostrum* and *Choneziphius*, but differs from all known ziphiids by a very deep excavated prenarial basin with a semicircular outline in lateral view. This peculiar cranial architecture of *Caviziphius* might indicate an advanced and efficient mechanism of sound production in this fossil ziphiid.

Keywords: Cetacea, Ziphiidae, Miocene, North Sea, new taxon

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INTRODUCTION

Miocene and Pliocene marine deposits from the southern North Sea Basin are a very important source of fossil cetaceans (odontocetes and mysticetes). Most specimens originate from the Antwerp area in Belgium, but important fossils have also been collected from the Netherlands and the North Sea. The Eurhinodelphinidae, Physeteridae and Ziphiidae are remarkably abundant among the Miocene odontocetes. The Ziphiidae are represented by a large number of specimens, but only occasionaly received proper scientific attention (Cuvier 1823; Du Bus 1872; Van Beneden & Gervais 1868-1879; Owen 1888; Abel 1905; Weber 1917; Van Deinse 1931; Muizon 1991; Van Bree 1997 and Post 1998). Also Abel's (1905) systematic review does not reflect the great diversity of Miocene ziphiids of the North Sea (pers. obs.; O. Lambert, pers. comm.). This diversity of ziphiids in the Miocene North Sea is emphasized by the recent discovery of a partial cranium, here described and referred to a new genus and species.

The anatomical terminology utilized follows Heyning (1989) and measurements were made according the methods used by Moore (1963).

SYSTEMATIC PALEONTOLOGY

Class Mammalia LINNAEUS, 1758
Order Cetacea BRISSON, 1762
Suborder Odontoceti FLOWER, 1867
Family Ziphiidae GRAY, 1865

Caviziphius n. gen.

Diagnosis A genus of Ziphiidae with architecture and elevation of the vertex similar to *Choneziphius* and *Ziphirostrum*, but with stronger right premaxillary crest. Differs from all other genera of the family, except *Messapicetus*, *Choneziphius*, and *Ziphirostum*, by featuring a closed mesorostral canal. Differs

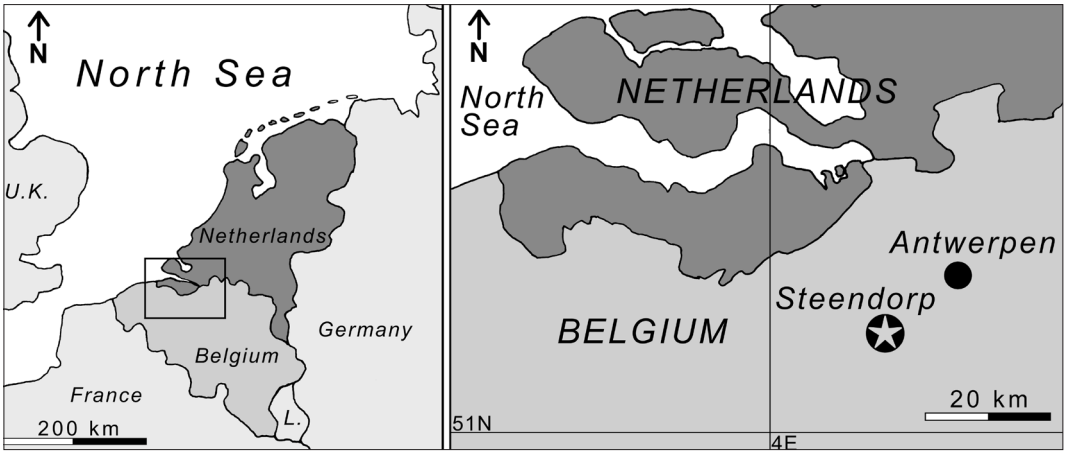

Figure 1 Geographic location of Steendorp (Belgium).

from all other genera of this family in having a peculiar deep excavated prenarial basin on the dorsal surface of the posterior portion of the rostrum. This basin is formed by two asymmetrical prenarial fossae, separated by a longitudinal convexity and has a semicircular outline in lateral view.

Type and only included species
Caviziphius altirostris n. sp.

Etymology The genus name is from the Latin *cavus*, for the deep dorsal concavity of the skull caused by the prenarial basin, and from *Ziphius*, name of the type-genus of the family.

Caviziphius altirostris n. sp.

Diagnosis See genus diagnosis.

Holotype ST. 447230 - Naturalis, National Museum of Natural History, Leiden, The Netherlands. Incomplete skull lacking the most anterior portion of the rostrum, orbital areas, occipital, squamosals, ear bones and the entire ventral surface of the neurocranium (Figs. 2 and 3).

Etymology The species name is from the Latin *altus* and *rostrum*, for its very high rostrum rising from the deep excavation of the anterior dorsal surface of the neurocranium.

Horizon and locality The skull was collected by mr. O. Stolzenbach in the Belgian village of Steendorp, on the west side of the clay pit at the Blauwhofstraat (51º07'N, 04º16'E; Fig. 1). At the site, c. 2.5 m of Early Pliocene marine shelly sands cover approximately 20 cm of a Miocene basal gravel ('Post Mioceen Basisgrind'), rich in phosphate nodules, shark teeth and fossils of marine mammals; this gravel lays on top of thick layers of commercially exploited Oligocene (Rupelian) clay ('Klei van Boom'; J. Herman, pers. comm.). The basal gravel is known to consist of reworked Late Oligocene to Latest Miocene marine matrix and is present in most of northwestern Belgium, the southwestern Netherlands and parts of the southern North Sea (Janssen 1974; De Ceuster 1976). Most of the marine mammal fossils from this gravel show a grade of wear and are of Middle to Late Miocene origin. The large collections of rostra of *Choneziphius* and *Mesoplodon* in the Netherlands and Belgium originated mainly from this basal gravel.

Part of the damage of the fossil cranium was caused by mechanical excavators, but it is still more complete than most of the well known rostra of *Choneziphius* and *Mesoplodon*. Based on the relatively good preservation of the skull, a Late Miocene origin of the cranium seems most plausible, however proof cannot be given and therefore we refer to a, more general, Miocene origin.

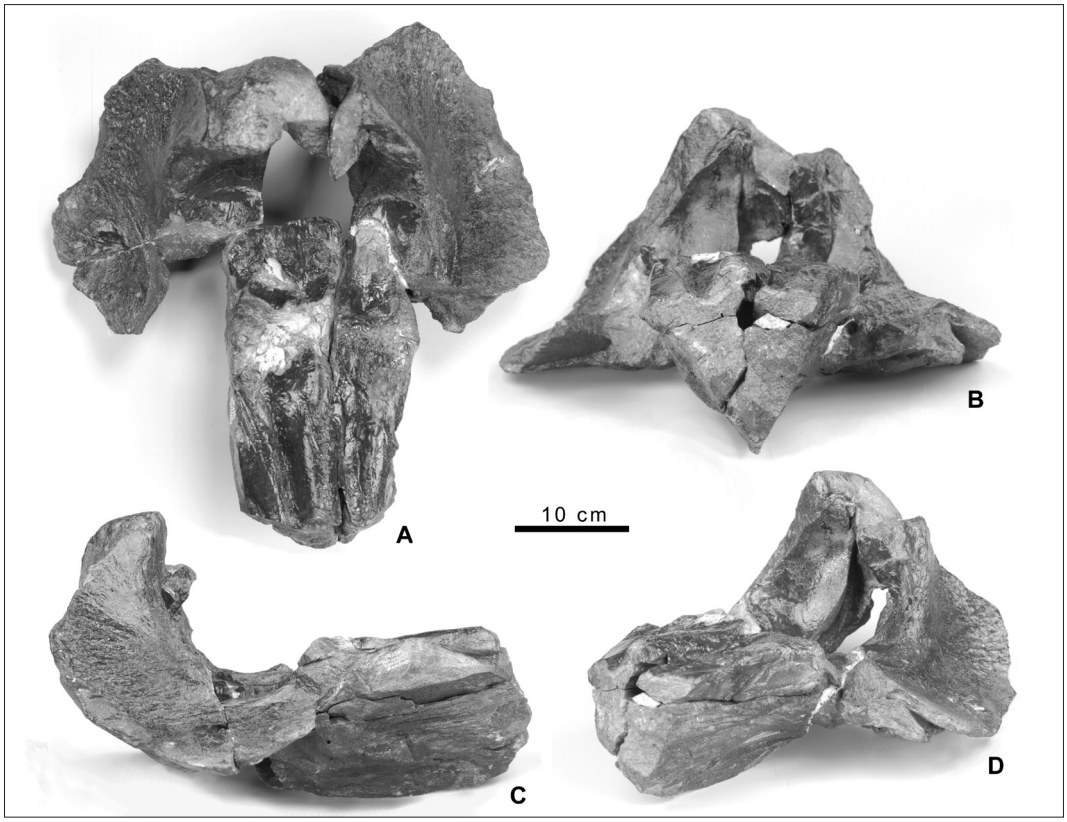

Figure 2 Holotype skull ST. 447230 of *Caviziphius altirostris*. **A** dorsal view; **B** anterior view; **C** lateral view; **D** anterolateral view.

Description Considering the incompleteness of the holotype, the description is limited to the posterior portion of the rostrum, the dorsal surface of the prenarial area and the vertex. Although the vertex is partially damaged, it still allows a reliable reconstruction of the general arrangement of the nasals and premaxillary crests.

The size of the neurocranium was large, similar to that of living *Ziphius*. If we compare the dimensions of the solid and massive base of the rostrum with similar genera, such as *Choneziphius* and *Ziphirostrum*, we might conclude that the partially preserved rostrum was originally probably quite elongated.

The preserved posterior portion of the rostrum is sturdy pachy-osteosed. In transverse section, it is triangular and shows a small circular cavity caused by the dorsal closure of the mesorostral canal. The dorsal edge of this transverse section of the rostrum shows a large medial convexity and two small lateral concavities. The medial convexity corresponds to the partial overlap of the right premaxilla over the left premaxilla, resulting in the closure of the mesorostral canal. This medial convexity turns posterior slightly to the left side of the skull and disappears at the base of the rostrum, where the dorsal surface becomes flat. The two small lateral concavities on the dorsal edge of the rostral section are formed by two longitudinal depressions lateral to the midline of the rostrum. The right depression widens, and extends more posteriorly than the left one. These two depressions may represent the posterior portions of the premaxillae. Quite remarkably, the premaxillae are fairly wide at the dorsal surface of the preserved portion of the rostrum. Just posterior to the base of the rostrum each premaxilla exhibits a deep and

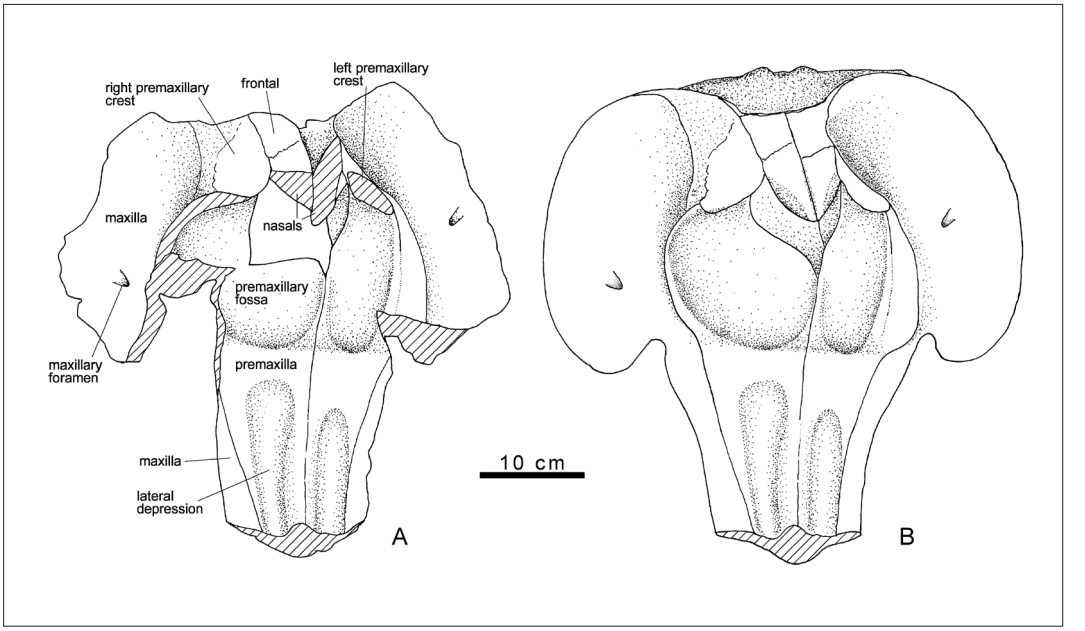

Figure 3 Dorsal view of holotype skull ST. 447230 of *Caviziphius altirostris*. **A** as preserved; **B** reconstruction.

circular fossa for the premaxillary sac. The right premaxilla is more sturdy and wider than the left premaxilla and consequently also the right fossa (which extends over the entire dorsal surface of the premaxilla) is larger than the left. The two fossae are separated medially by the longitudinal convexity that corresponds to the overlap of the premaxillae. At their base, the two fossae form a wide and very deep prenarial basin that slopes very steeply down from the posterior portion of the rostrum. This hemispherical excavation at the base of the rostrum is limited laterally by the upward incline of the premaxillae and maxillae, and posterior by the vertical and elevated ascending portions of the premaxillae.

The vertex is relatively elevated and is not laterally compressed (Fig. 4). It is not located exactly on the medial line of the skull, but slightly inclines to the left side of the cranium. The premaxillary crests are anteriorly expanded and the right crest is larger than the left. The premaxillary-maxillary suture on the vertex is straight and there is no posterolateral curving of the premaxillary crests. The nasals are triangular and anteroposteriorly elongated, and the right one is larger than the left one. Posterior to the nasals the preserved right frontal is wide and anteroposteriorly extended, therefore the frontals form a conspicuous part of the vertex. The preserved lateral portion of dorsal surface of the maxilla is flat and there is no evidence of a maxillary crest. Posteromedially, the maxilla slopes vertically towards the vertex and forms a strongly concave facial fossa.

In lateral view, one clearly observes the very deep rostrum, the pronounced prenarial basin with a semicircular outline and the vertical and elevated ascending parts of the premaxillae.

In anterior view, it is evident that the right premaxillary crest is more elevated than the left one. In this view the nasals appear extremely dorsoventrally elongated and possess a slightly concave dorsal edge. Anterior to the nasals, the mesethmoid shows a ventral and vertical slope.

The ventral surface of skull is in bad condition and the ventral wall of the braincase is missing. The wide impression for the pterygoid sinus extends anteriorly to all the preserved parts of the rostrum.

Comparisons *Caviziphius* shows the peculiar ziphiid architecture of the vertex (Moore 1968) and this area in particular agrees in general shape with *Choneziphius* and *Ziphirostrum*, two other Miocene ziphiids from Belgium (Abel 1905). The latter genera also possess large and triangular nasals and their premaxillary crests are elongated and do not contact the nasals anteriorly. Nevertheless, the vertex of *Caviziphius* differs from that of *Ziphirostrum* and *Choneziphius* because of its larger and more elevated right premaxillary crest. A similar outline of the vertex in anterior view as in *Caviziphius*, is found in *Tusciziphius* from the Early Pliocene of Italy (Bianucci 1997; Bianucci *et al.* 2001). However, the vertex of *Caviziphius* differs from *Tusciziphius* in its greater width and in the lack of the anterior contacts between the premaxillary crests and nasals. Within the extant ziphiids, the vertex of *Caviziphius* is most similar to *Ziphius*, but differs from this genus by the stronger right premaxillary crest and the lack of anterior contact between the left nasal and the left premaxillary crest.

The most peculiar characteristic of *Caviziphius* is a very deep prenarial basin, a dorsal concavity of the neurocranium that, in extant ziphiids, is only found in adult males of *Ziphius cavirostrum* (Heyning 1989). A similar but weaker concavity is also found in fossil *Choneziphius* and *Ziphirostrum*. *Caviziphius*, *Ziphius* and *Choneziphius* also share the same strong asymmetry of the spiracular plates.

The architecture of the prenarial area of *Caviziphius* is unique among ziphiids for its very broad premaxillae anteriorly to the base of the rostrum, and for its very deep prenarial basin with a medial convexity and a semicircular shape in lateral view. The rostrum of *Cavezіphius* differs from *Choneziphius* and *Ziphius* by showing two dorsal longitudinal depressions, which probably might have been present over the entire original length of the rostrum.

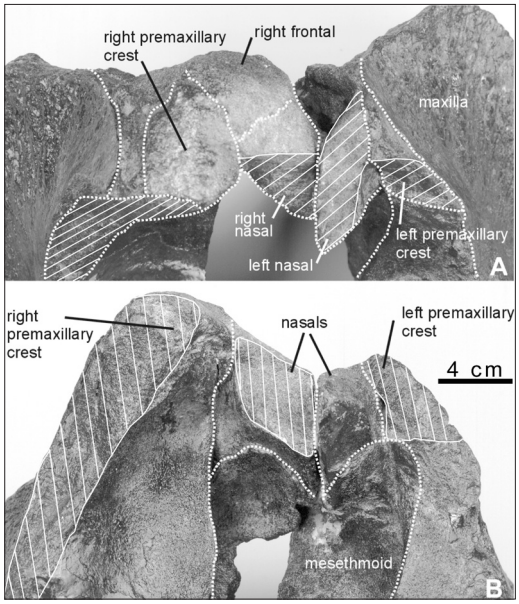

Figure 4 Vertex of holotype skull ST. 447230 of *Caviziphius altirostris*. **A** dorsal view; **B** anterior view.

DISCUSSION AND CONCLUSIONS

Caviziphius is a large and advanced ziphiid, characterized by a very deep and asymmetrical prenarial basin. In extant odontocetes, a prenarial basin is only found in adult males of the genus *Ziphius*, where it is filled with an enlarged right nasal plug: a fleshy lobe composed of very fatty tissue (Heyning 1989). This right nasal plug might be involved in sound production (Norris *et al.* 1971; Dormer 1979; Heyning 1989) and therefore the peculiar architecture of the skull of *Caviziphius* may indicate an advanced and efficient mechanism of sound production in this fossil ziphiid.

From a phylogenetic point of view, *Caviziphius* is probably closely related to *Choneziphius* but seems even more derived than this genus because of the more pronounced and deeper prenarial basin and the stronger asymmetry of the premaxillary crests. However, a detailed phylogenetic analysis is beyond the scope of this work. A significant collection of Miocene ziphiids from the Institut Royal des Sciences Naturelles de Belgique, Brussels is presently under study and important facts pertaining the origin of the ziphiids and the phylogenetic position of *Caviziphius* and other genera might be expected (O. Lambert, pers. comm.).

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