

3D models related to the publication: Protocetid (Cetacea, Artiodactyla) bullae and petrosals from the Middle Eocene locality of Kpogamé, Togo: new insights into the early history of cetacean hearing.

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Abstract

This contribution contains the 3D models described and figured in the following publication: Mourlam, M. J., Orliac, M. J. (2017), Protocetid (Cetacea, Artiodactyla) bullae and petrosals from the Middle Eocene locality of Kpogamé, Togo: new insights into the early history of cetacean hearing. *Journal of Systematic Palaeontology* <https://doi.org/10.1080/14772019.2017.1328378>

Keywords: archaeocete, auditory region, Lutetian, petrotympanic complex

Submitted:2017-01-06, published online:2017-05-31. <https://doi.org/10.18563/m3.3.1.e2>

INTRODUCTION

The 3D models presented here (see Table 1) are part of the protocetid whales specimens retrieved from the Lutetian bone bed of Kpogamé-Haotoé (Togo; Cappetta and Traverse 1988; Gingerich and Cappetta 2014) and described by Mourlam and Orliac (2017). The auditory region of protocetid whales is only partly known, and the Middle Eocene locality of Kpogamé, Togo (46 - 43 Ma) yielded abundant material documenting the auditory region of these extinct cetaceans. In a detailed study of this material, Mourlam and Orliac (2017) reassessed the original taxonomic attribution of this material originally described by Gingerich and Cappetta (2014), and describe three different protocetid taxa on the basis of bullar and petrosal remains: *?Carolinacetus* sp., *Togocetus traversei*, and a Protocetidae indeterminate (γ). CT-Scan investigation of ear region remains from Kpogamé revealed new important morphological observations: a complete tympanic ring similar to that of terrestrial artiodactyls was still present in Protocetidae and their involucrum could probably articulate with the medial side of the ventral surface of the petrosal. The 3D models provided here allow observing the morphology of protocetid petrosals and bulla of the three protocetids from Kpogamé, including these newly described features. They document: i) the isolated petrosal UM-KPG-M 164 and the auditory bulla UM-KPG-M 33 referred to as *?Carolinacetus* sp., ii) the skull fragment UM-KPG-M 73 preserving the petrotympanic complex and parts of the basioccipital and squamosal bones (Fig. 1) referred to as Protocetidae indeterminate (γ), iii) the fragmentary auditory bulla UM-KPG-M 80 referred to as *Togocetus traversei*.

Model IDs	Taxon	Description
M3#132_UMK PG-M164	<i>?Carolinacetus</i> <i>sp.</i>	left petrosal
M3#133_UMK PG-M73	Protocetidae <i>indet. (γ)</i>	left petrosal
M3#134_UMK PG-M73	Protocetidae <i>indet. (γ)</i>	left bulla
M3#135_UMK PG-M73	Protocetidae <i>indet. (γ)</i>	left bulla and petrosal
M3#136_UMK PG-M33	<i>?Carolinacetus</i> <i>sp.</i>	left bulla
M3#137_UMK PG-M80	<i>Togocetus</i> <i>traversei</i>	fragmentary right bulla

Table 1. List of models

METHODS

The 3D surface of the left isolated petrosal UM-KPG-M 164 was extracted semi-automatically within AVIZO 8.0 (Visualization Sciences Group) using the segmentation threshold selection tool. The sediment present in the internal auditory meatus and in the foramina surrounding the promontorium was removed virtually slice-by-slice manually with the limited range only option of the brush tool of AVIZO 8.0. We extracted the digital casts of the bulla and of the petrosal of the skull fragment UM-KPG-M 73 slice-by-slice manually with the limited range only option of the brush tool of AVIZO 8.0. The rather low contrast of the CT scan acquisition, and the presence of sediment and recrystallization in the cavities made the segmentation process long and complicated. The

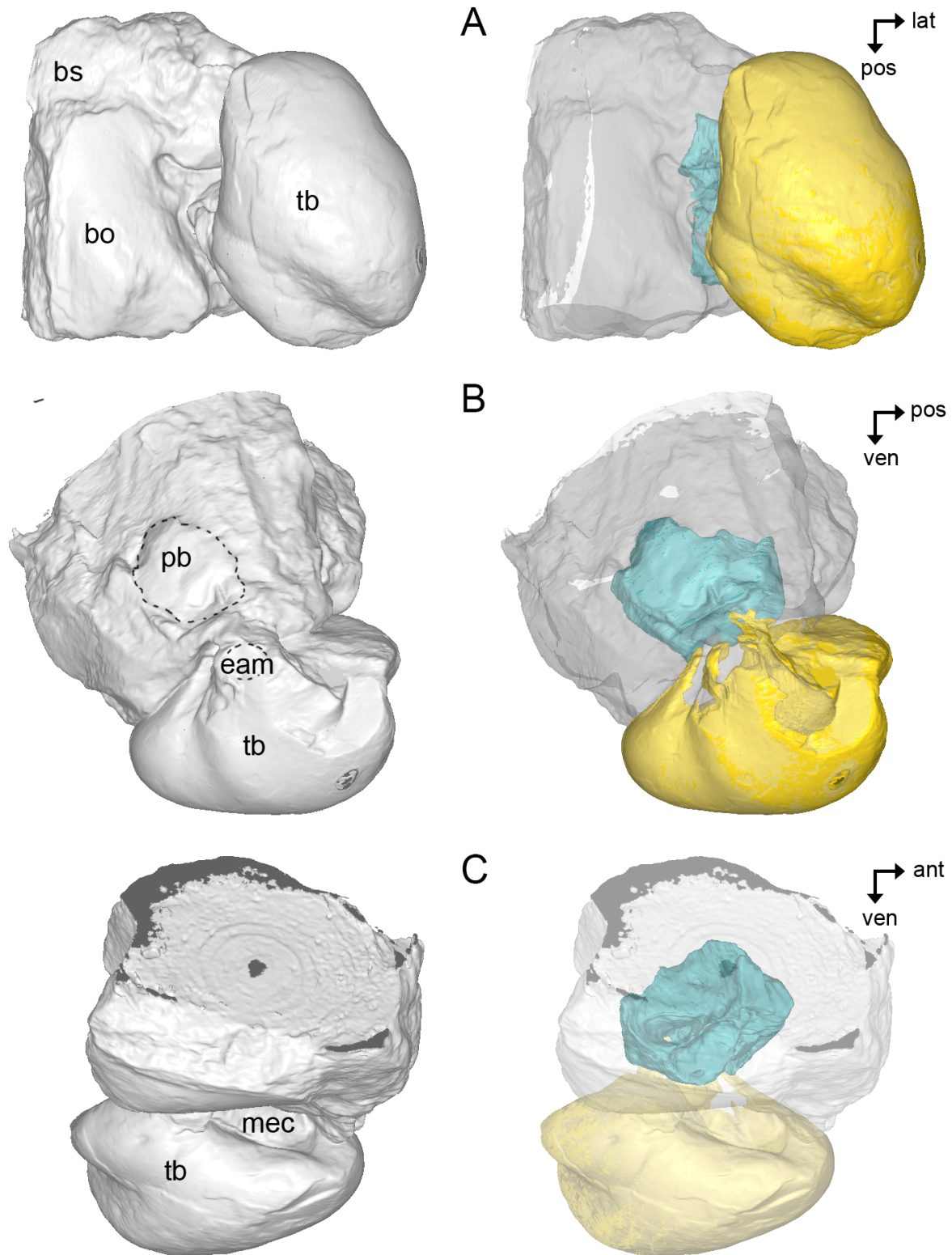


Figure 1. Skull fragment UM-KPG-M 73, surface views and translucent rendering of the matrix and braincase bones showing the petrotympanic complex in situ. A) ventral view, B) lateral view, C) medial view. Abbreviations: bo, basioccipital; bs, basisphenoid; eam, external auditory meatus; mec, middle ear cavity; pb, petrosal bone; tb, tympanic bulla. Scale bar = 50 mm

3D surface models are provided in .ply format, and can therefore be opened with a wide range of freeware. Additional flag files specific to ISE-MeshTools (Lebrun, 2014) are provided in order to visualize the 3D labelled models in standard orientation.

ACKNOWLEDGEMENTS

We are grateful to M. Bouchet, C. Charles, and J. Martin for access to the AniRA-ImmOs (SFR Biosciences Gerland-Lyon) microtomography facility. This study was supported by the ANR/ERC funding project PALASIAFRICA, headed by L. Marivaux. Data presented in this work were produced through the technical facilities of the MRI platform and of the labEx CeMEB.

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