Geobios 46 (2013) 329–334

Available online at
SciVerse ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com

Original article

# The status of *Mastodon angustidens pygmaeus* Depéret, 1897 (Proboscidea, Mammalia): The contribution of X-ray tomography☆

Pascal Tassy [a,*], Florent Goussard [b], Miguel Garcia Sanz [b]

[a] *Muséum national d'histoire naturelle, département histoire de la Terre, UMR7207 CNRS-MNHN-UPMC CR2P, CP 38, 57, rue Cuvier, 75231 Paris cedex 05, France*
[b] *Muséum national d'histoire naturelle, plateforme AST-RX (accès scientifique à la tomographie à rayons X), département systématique et évolution, UMS 2700 CNRS-MNHN outils et méthodes de la systématique intégrative, CP140, 57, rue Cuvier, 75231 Paris cedex 05, France*

ARTICLE INFO

*Article history:*
Received 24 September 2012
Accepted 28 January 2013
Available online 30 April 2013

*Keywords:*
Proboscidea
*Gomphotherium pygmaeum*
*Choerolophodon pygmaeus*
Molar
X-ray tomography

ABSTRACT

The status of *Mastodon angustidens pygmaeus* Depéret, 1897 is discussed on the basis of an examination of the holotype (a broken lower molar) with tomography using X-rays, and on a review of the previous taxonomic hypotheses. The conclusion is that the holotype is a possible supernumerary post-m3 molar that may be that of a tetralophodont gomphothere. "*M. angustidens pygmaeus*" is then a *nomen dubium* that should only be used in relation to the holotype.



## 1. Introduction

Today, a young palaeontologist and/or phylogenetist is first of all an internaut. If he/she is interested by the phylogeny of Proboscidea Illiger, 1811, he may search the Internet and find the address http://www.palaeos.org/Gomphotherioidea. There, he/she will find a peculiar phylogeny of the "Gomphotherioidea", including a taxon labelled "*Gomphotherium pygmaeus* (Depéret, 1897)". From various viewpoints (palaeontological, odontological, anatomical, evolutionary, and nomenclatural), the history of this problematic taxon and of its name is worth recalling with an explanation both frustrating and rational.

The original name was conceived by Charles Depéret (1897: p. 519, pl. 19, figs. 1–3) as a trinom: "*Mastodon angustidens* Cuv. mut. asc. *pygmaeus*", based on a molar lacking the first lophid, and interpreted as an m3. The abbreviation "mut. asc." means "mutation ascendante", that is "ascending mutation" (discussed below). The original hypodigm includes only the holotype which was found in Kabylie (Algeria) during a geologic excursion organized by the Société géologique de France in post-Paleogene outcrops, the "grès cartenniens à Clypéastres qui affleurent dans la tranchée de la route entre Chabet-el-Ameur et Isserville (Kabylie)". The molar looks like a germ of a bunolophodont m3 (Fig. 1) and Depéret pointed its peculiarities: small size (complete, the molar could have reached only 110 mm), large amount of coronal cement and "faible dédoublement des mamelons principaux en mamelons secondaires" (Depéret, 1897: p. 519), i.e., weak development of mesoconelets (labial and lingual conelets on each side of the median sulcus).

This molar has been interpreted in many ways since its identification as a gomphothere, a palaeomastodont, a choerolophodont, a supernumerary molar, and a *nomen dubium*. The taxonomic challenge introduced by this molar is that a thick coating of cement entirely occupies the interlophids (except the first, where the molar is broken). As a consequence, the organization of the central conules, which brings taxonomic information, cannot be seen since the central conules are hidden (Fig. 1). This is why numerous hypotheses have been erected, although the shape of the anterior pretrite central conule of the anteriorly-preserved lophid could have already disclosed some of them. Because the molar is a holotype, nobody dared to clean the interlophids. The non-destructive technique of X-ray tomography allows a virtual dissection and show for the first time the pattern of the crown and the shape of central conules (Figs. 2–5).

**Abbreviations**: IM, Indian Museum (Calcutta, India); UCBCG, Université Claude Bernard Lyon 1, France (Collections de Géologie); MNHN, Muséum national d'Histoire naturelle (Paris, France).

## 2. Material and methods

The holotype of *Mastodon angustidens pygmaeus* belongs to the collection of geology of the University Claude Bernard Lyon 1, France (UCBCG), with number FSL 213759.

☆ Corresponding editor: Gilles Escarguel.

* Corresponding author.
*E-mail address:* ptassy@mnhn.fr (P. Tassy).

0016-6995/$ – see front matter © 2013 Elsevier Masson SAS. All rights reserved.
http://dx.doi.org/10.1016/j.geobios.2013.01.003

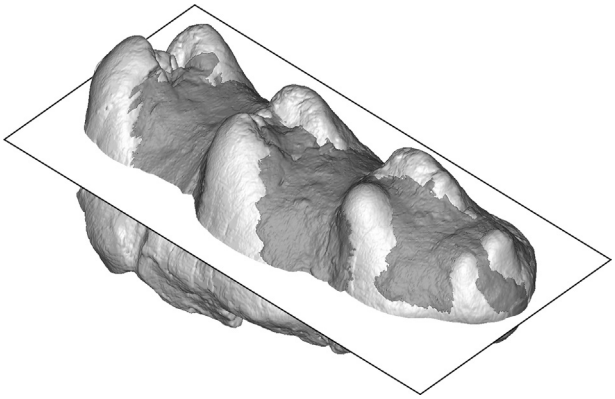

**Fig. 1.** Holotype of *Mastodon angustidens pygmaeus* Deperet, 1897, FSL 213759 (UCBCG), incomplete right?supernumerary tooth (post-m3), Kabylie, Algeria. The horizontal plane corresponds to the section seen in Fig. 2. Seen from behind. Anterior to the left.

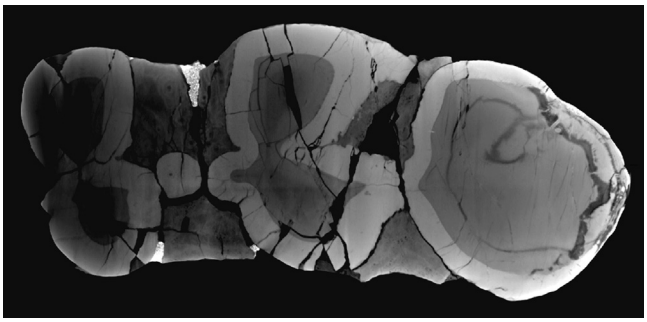

**Fig. 2.** Holotype of *Mastodon angustidens pygmaeus* Deperet, 1897, FSL 213759 (UCBCG), incomplete right?supernumerary tooth (post-m3). Section of the molar made by tomography according to Fig. 1. The round section of the central conules of the anteriorly-preserved interlophid is clearly seen. Anterior to the left.

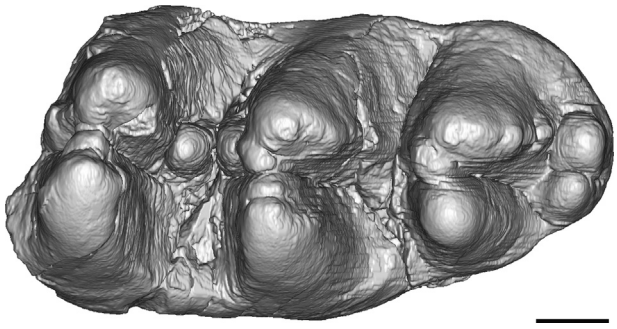

**Fig. 3.** Holotype of *Mastodon angustidens pygmaeus* Deperet, 1897, FSL 213759 (UCBCG), incomplete right?supernumerary tooth (post-m3). Occlusal view of the crown with virtual extraction of the cement. Anterior to the left. Scale bar: 10 mm.

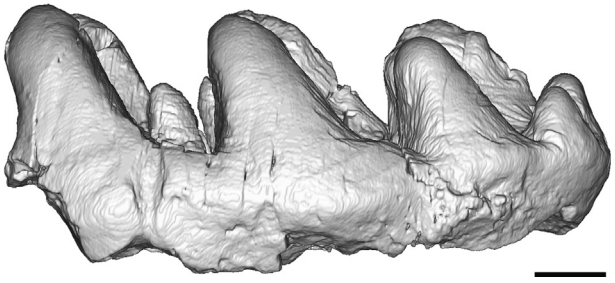

**Fig. 4.** Holotype of *Mastodon angustidens pygmaeus* Deperet, 1897, FSL 213759 (UCBCG), incomplete right?supernumerary tooth (post-m3). Lingual view of the crown with virtual extraction of the cement. Anterior to the left. Scale bar: 10 mm.

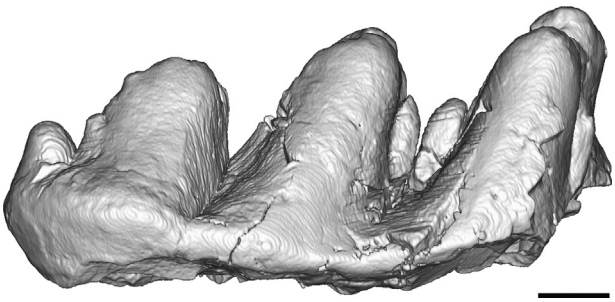

**Fig. 5.** Holotype of *Mastodon angustidens pygmaeus* Deperet, 1897, FSL 213759 (UCBCG), incomplete right?supernumerary tooth (post-m3). Labial view of the crown with virtual extraction of the cement. Anterior to the right. Scale bar: 10 mm.

CT scanning was conducted by M.G.S. at the X-ray Tomography Imagery Platform AST-RX of the MNHN, using a GE Sensing and Inspection Technologies phoenix|x-ray v|tome|x L240-180 CT scanner. The scan was made with an isotropic voxel size of 52.94 μm under a voltage of 210 kV and a current of 240 μA. Three thousand projections over 360 degrees with 333 milliseconds of exposure time were used, with three averaged images per projection and one skipped image before each projection. The data were reconstructed using phoenix datos|x® 2.0 reconstruction software, and then exported into a 16 bits TIFF image stack of 1776 slices.

Post-processing was realized by F.G. at the Paleontology Imaging Unit of the MNHN Département Histoire de la Terre/CNRS UMR 7207. In order to optimize the post-processing, the stack was corrected (level balance, brigthness/contrast), reduced to 60% of its original size in the three dimensions, and converted in 8 bits with Fiji software (Schindelin et al., 2012) for a final image stack of 1059 slices with an isotropic voxel size of 88.24 μm. Mimics® v.14.12 and v.15.0 (Materialise) were used for the 3D-modelling (segmentation and 3D-object rendering): first, the entire specimen was segmented on a mask; second, the cement was segmented on a separate mask; third, a boolean operation was performed to remove the second mask from the first, resulting in a virtual extraction of the cement from the interlophids of the molar.

## 3. Systematic palaeontology

The phylogenetic classification under, taken from Shoshani et al. (1998), does not use explicit ranks.

PROBOSCIDEA Illiger, 1811
ELEPHANTIFORMES Tassy, 1988
ELEPHANTIMORPHA Shoshani and Tassy *in* Shoshani et al. 1998
ELEPHANTIDA Shoshani and Tassy *in* Shoshani et al., 1998
*Mastodon pygmaeus* Depéret, 1897 *nomen dubium*

**Holotype**: incomplete right supernumerary tooth (?post-m3), FSL 213759 (UCBCG).

**Hypodigm**: the holotype.

**Occurrence**: Neogene of Isser (wilaya of Boumerdès), Algeria.

**Remarks**: previous illustrations of the holotype are found in Depéret (1897), Osborn (1936), Bergounioux and Crouzel (1959), and Pickford (2004). Yet, the occlusal surface described here is seen for the first time (Figs. 2–5; Appendix A).

The mesial face of the molar is broken, without a doubt. What is left of the first interlophid is the anterior wall of the second lophid; the first is entirely missing. On this lophid, the thinly-crenulated conule on the pretrite half-lophid is rectilinear, without turning lingually at the base of the crown: it is crest-like, that is a central conule of serridentine shape, not the anterior cristid of a first lophid connected to a precingulum. As a consequence, certainly the complete tooth had more lophids, likely four (or even more,