



HAL
open science

3D models related to the publication: An unexpected late paroxyclaenid (Mammalia, Cimolesta) out of Europe: dental evidence from the Oligocene of the Bugti Hills, Pakistan

Floréal Solé, Laurent Marivaux

► To cite this version:

Floréal Solé, Laurent Marivaux. 3D models related to the publication: An unexpected late paroxyclaenid (Mammalia, Cimolesta) out of Europe: dental evidence from the Oligocene of the Bugti Hills, Pakistan. *MorphoMuseum*, 2024, 10, pp.e182. 10.18563/journal.m3.182 . hal-04761968

HAL Id: hal-04761968

<https://hal.umontpellier.fr/hal-04761968v1>

Submitted on 31 Oct 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

3D models related to the publication: An unexpected late paroxyclaenid (Mammalia, Cimolesta) out of Europe: dental evidence from the Oligocene of the Bugti Hills, Pakistan

Floréal Solé¹, Laurent Marivaux^{2*}

¹ Directorate Earth and History of Life, Royal Belgian Institute of Natural Sciences, Rue Vautier 29, B-1000 Brussels, Belgium

² Institut des Sciences de l'Évolution de Montpellier (ISE-M, UMR 5554, CNRS/UM/IRD/EPHE), c.c. 064, Université de Montpellier, place Eugène Bataillon, 34095 Montpellier Cedex 05, France

*Corresponding author: Laurent.Marivaux@UMontpellier.fr

Abstract

This contribution contains the three-dimensional digital models of eleven isolated fossil teeth of a merialine paroxyclaenid (*Welcommoides gurki*), discovered from lower Oligocene deposits of the Bugti Hills (Balochistan, Pakistan). These fossils were described, figured and discussed in the following publication: Solé et al. (2024), An unexpected late paroxyclaenid (Mammalia, Pantolesta) out of Europe: dental evidence from the Oligocene of the Bugti Hills, Pakistan. Papers in Palaeontology. <https://doi.org/10.1002/spp2.1599>

Keywords: Indian Subcontinent, Merialinae, Paleobiogeography, Paleogene, Paroxyclaenidae

Submitted:2022-10-26, published online:2024-10-31. <https://doi.org/10.18563/journal.m3.182>

INTRODUCTION

We present here the three-dimensional (3D) digital models of eleven isolated dental remains of a fossil Paroxyclaenidae (Fig. 1; Table 1) that were unearthed in detrital lower Oligocene deposits (Bugti Member, Chitarwata Formation) at the Paali Nala locus 2 locality (DBC2), situated on the south flank of the Zin anticline, Bugti Hills, Balochistan, Pakistan (e.g., Marivaux et al., 1999, 2001, 2002, 2005; Welcomme et al., 2001; Marivaux and Welcomme, 2003; Métais et al., 2009, 2017). These specimens (two well-preserved lower molars, one partial lower molar [trigonid], seven moderately well-preserved upper molars, and one pristine deciduous upper premolar) have allowed the description of a new merialine paroxyclaenid (*Welcommoides gurki* Solé et al., 2024), which is the largest and latest species of the group to be known thus far. The occurrence of this paroxyclaenid representative in the Oligocene of Pakistan is somewhat unexpected inasmuch as these mammals were so far only known during the Eocene in Europe. *Welcommoides* is a late representative out of Europe of that poorly-known mammal group. It displays a suite of unusual dental characters compared with merialines, thereby suggesting that this South Asian lineage had diverged for some time from its lower Eocene European counterparts (Solé et al., 2024). The discovery of a merialine paroxyclaenid in the Oligocene of Pakistan provides an additional example in support of the hypothesis that low latitudes of South Asia were a tropical refugium during the global climatic deterioration recorded at the Eocene/Oligocene transition (Beard, 1998; Qi and Beard, 1998; Marivaux et al., 2002; 2005, 2006; Jablonski, 2003; Marivaux, 2006; Coxall and Pearson, 2007; Ni et al., 2016; Solé et al., 2024).

Inv nr.	Description
UM-DBC 2225	Left m3
UM-DBC 2226	Right m3
UM-DBC 2227	Trigonid of a right lower molar
UM-DBC 2230	Right DP4
UM-DBC 2228	Right M1
UM-DBC 2229	Right M2
UM-DBC 2236	Left M2
UM-DBC 2231	Left M3
UM-DBC 2232	Left M3
UM-DBC 2234	Left M3
UM-DBC 2233	Left M3

Table 1. List of models of specimens belonging to *Welcommoides gurki*. Collection: Institut des Sciences de l'Évolution de Montpellier, Université de Montpellier, France.

METHODS

The dental specimens documenting *Welcommoides gurki* from the Oligocene of Pakistan (Fig. 1) were scanned with a resolution of 5 µm, using a µCT-scanning station EasyTom 150 / Rx Solutions (Montpellier RIO Imaging, ISE-M, Montpellier, France). AVIZO 2020.2 (Visualization Sciences Group) software was used for visualization, segmentation, and three-dimensional (3D) rendering. The isolated teeth were prepared within a “labelfield” module of AVIZO, using the segmentation threshold selection tool. The crown and roots of each tooth were virtually delimited by manual segmentation. The 3D models are provided in “.ply” format, and thus can be opened with a wide range of software programs (e.g., MorphoDig 1.6.7, an open-source 3D freeware (Lebrun, 2018; <https://morphomuseum.com/Pages/morphodig>).

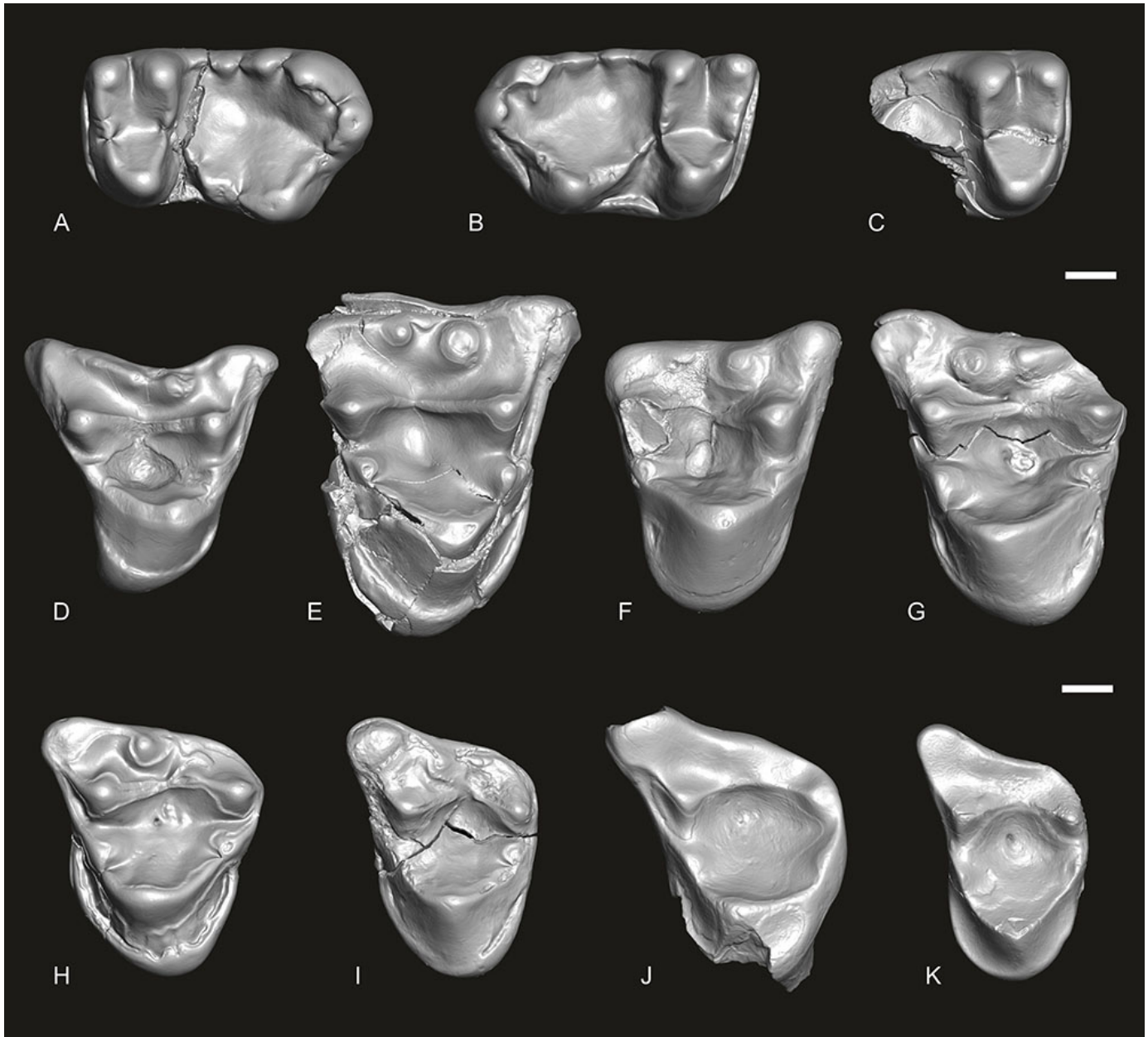


Figure 1. Fossil dental specimens of *Welcommoides gurki* Solé et al. 2024, from the early Oligocene of the Bugti Hills DBC2 (Balochistan, Pakistan). A) UM-DBC 2225, left lower m3; B) UM-DBC 2226 (Holotype), right lower m3; C) UM-DBC 2227, trigonid of a right lower molar; D) UM-DBC 2230, right deciduous fourth upper premolar (DP4); E) UM-DBC 2228, right upper M1; F) UM-DBC 2229, right upper M2; G) UM-DBC 2236, left upper M2; H) UM-DBC 2231, left upper M3; I) UM-DBC 2232, left upper M3; J) UM-DBC 2234, left upper M3; K) UM-DBC 2233, left upper M3. Images are renderings of 3D digital models of the fossil specimens, obtained by X-ray micro-computed (μ CT) surface reconstructions (renderings of segmented surfaces). Scale bars: 1 mm.

ACKNOWLEDGEMENTS

The 3D data presented in this work were produced through the technical facilities of the Montpellier RIO Imaging (MRI) platform (ISE-M, *Université de Montpellier*) and of the LabEx CeMEB. We particularly thank Anne-Lise Charruault (ISE-M, *Université de Montpellier*) for μ CT-scan acquisitions, treatments, and reconstructions. Fieldwork seasons (1999-2004) that led to the discovery of the fossils presented here were supported by the L. S. B. Leakey, *Fyssen* and *Singer Polignac* foundations, the Ministry of Foreign Affairs (MAE) via the French Embassy in Islamabad (Pakistan), the CNRS (Eclipse-Program), and the *Institut des Sciences de l'Evolution de Montpellier* (ISE-M). The digitalization (scans) of these fossils also benefited from the *Agence Nationale de la Recherche* (ANR) in the framework of the former PALASIAFRICA program (ANR-08-JCJC-0017). ISE-M publication n° 2024-241.

BIBLIOGRAPHY

- Beard, K.C., Dawson, M.D. (Eds.), 1998. Dawn of the Age of Mammals in Asia. *Bulletin of Carnegie Museum of Natural History*, Pittsburgh. <https://doi.org/10.5962/p.228609>
- Coxall, H.K., Pearson, P.N., 2007. The Eocene–Oligocene Transition. In: Williams, M., Haywood, A.M., Gregory, F.J., Schmidt, D.N. (Eds.), *Deep-Time Perspectives on Climate Change: Marrying the Signal from Computer Models and Biological Proxies*. The Micropalaeontological Society, Special Publications. The Geological Society, London, pp. 351-387. <https://doi.org/10.1144/TMS002.16>
- Jablonski, N.G., 2003. The evolution of tarsiid niche. In: Wright, P.C., Simons, E.L., Gursky, S. (Eds.), *Tarsiers: Past, Present, and Future*. Rutgers University Press, New Brunswick, New Jersey, pp. 35-49.
- Lebrun, R., 2018. MorphoDig, an open-source 3D freeware dedicated to biology. 5th International Paleontological Congress (IPC5) – *The Fossil Week*, July 9–13th, 2018 (Paris, France). Abstract volume, 399.
- Marivaux, L., 2006. The eosimiid and amphipithecoid primates (Anthropoidea) from the Oligocene of the Bugti Hills (Balochistan, Pakistan): new insight into early higher primate evolution in South Asia. *Palaeovertebrata* 34, 29-109.
- Marivaux, L., Antoine, P.-O., Baqri, S.R.H., Benammi, M., Chaimanee, Y., Crochet, J.-Y., De Franceschi, D., Iqbal, N., Jaeger, J.-J., Métais, G., Roohi, G., Welcomme, J.-L., 2005. Anthropoid primates from the Oligocene of Pakistan (Bugti Hills): data on early anthropoid evolution and biogeography. *Proceedings of the National Academy of Sciences, USA* 102, 8436-8441. <https://doi.org/10.1073/pnas.0503469102>
- Marivaux, L., Bocat, L., Chaimanee, Y., Jaeger, J.-J., Marandat, B., Srisuk, P., Tafforeau, P., Yamee, C., Welcomme, J.-L., 2006. Cynocephalid dermopterans from the Palaeogene of South Asia (Thailand, Myanmar, and Pakistan): systematic, evolutionary and paleobiogeographic implications. *Zoologica Scripta* 35, 395-420. <https://doi.org/10.1111/j.1463-6409.2006.00235.x>
- Marivaux, L., Vianey-Liaud, M., Welcomme, J.-L., 1999. Première découverte de Cricetidae (Rodentia, Mammalia) oligocènes dans le synclinal Sud de Gandoi (Bugti Hills, Balouchistan, Pakistan). *Comptes rendus de l'Académie des Sciences* 329, 839-844. [https://doi.org/10.1016/S1251-8050\(00\)88640-1](https://doi.org/10.1016/S1251-8050(00)88640-1)
- Marivaux, L., Welcomme, J.-L., 2003. Diatomyid and baluchimyine rodents from the Oligocene of Pakistan (Bugti Hills, Balochistan): systematic and paleobiogeographic implications. *Journal of Vertebrate Paleontology* 23, 420-434. [https://doi.org/10.1671/0272-4634\(2003\)023\[0420:NDABRF\]2.0.CO;2](https://doi.org/10.1671/0272-4634(2003)023[0420:NDABRF]2.0.CO;2)
- Marivaux, L., Welcomme, J.-L., Antoine, P.-O., Métais, G., Baloch, I.M., Benammi, M., Chaimanee, Y., Ducrocq, S., Jaeger, J.-J., 2001. A fossil lemur from the Oligocene of Pakistan. *Science* 294, 587-591. <https://doi.org/10.1126/science.1065257>
- Marivaux, L., Welcomme, J.-L., Ducrocq, S., Jaeger, J.-J., 2002. Oligocene sivaladapid primate from the Bugti Hills (Balochistan, Pakistan) bridges the gap between Eocene and Miocene adapiform communities in southern Asia. *Journal of Human Evolution* 42, 379-388. <https://doi.org/10.1006/jhev.2001.0529>
- Métais, G., Antoine, P.-O., Baqri, S.R.H., Crochet, J.-Y., De Franceschi, D., Marivaux, L., Welcomme, J.-L., 2009. Lithofacies, depositional environments, regional biostratigraphy and age of the Chitarwata Formation in the Bugti Hills, Balochistan, Pakistan. *Journal of Asian Earth Sciences* 24, 154-167. <https://doi.org/10.1016/j.jseaes.2008.04.006>
- Métais, G., Mennecart, B., Roohi, G., 2017. A new assemblage of stem pecoran ruminants from the Oligocene Chitarwata Formation, Bugti Hills, Baluchistan, Pakistan: Paleoenvironmental and paleobiogeographic implications. *Journal of Asian Earth Sciences* 136, 40-49. <https://doi.org/10.1016/j.jseaes.2016.09.009>
- Ni, X., Li, Q., Li, L., Beard, K.C., 2016. Oligocene primates from China reveal divergence between African and Asian primate evolution. *Science* 352, 673-677. <https://doi.org/10.1126/science.aaf2107>
- Qi, T., Beard, K.C., 1998. Late Eocene sivaladapid primate from Guangxi Zhuang Autonomous Region People's Republic of China. *Journal of Human Evolution* 35, 211-220. <https://doi.org/10.1006/jhev.1998.0240>
- Solé, F., Baqri, S.R.H., Roohi, G., Benammi, M., Crochet, J.-Y., De Franceschi, D., Antoine, P.-O., Marandat, B., Métais, G., Marivaux, L., 2024. An unexpected late paroxyclaenid (Mammalia, Cimolesta) out of Europe: dental evidence from the Oligocene of the Bugti Hills, Pakistan. *Papers in Palaeontology*, <https://doi.org/10.1002/spp2.1599>
- Welcomme, J.-L., Benammi, M., Crochet, J.-Y., Marivaux, L., Métais, G., Antoine, P.-O., Baloch, I., 2001. Himalayan Forelands: paleontological evidence for Oligocene detrital deposits in the Bugti Hills (Balochistan, Pakistan). *Geological Magazine* 138, 397-405.