Characterising the zegdoumyid rodent *Tsaukhaebmys* from the Ypresian/Lutetian of Black Crow, Namibia

Martin PICKFORD

Sorbonne Universités – CR2P, MNHN, CNRS, UPMC – Paris VI, 8 rue Buffon, 75005, Paris (martin.pickford@mnhn.fr)

Abstract: In a sample of limestone from Black Crow, Namibia, acid-treated in May, 2018, there was a complete germ of a lower third molar of the rodent *Tsaukhaebmys calcareus*. The crown is fully formed, but there are no roots, and the only sign of wear is a slight abrasion at the apex of the metaconid, possibly due to post-mortem processes rather than to occlusal wear. All the fine details of the crown morphology are clearly visible. Previous samples of lower molars of this species were either deeply worn or broken or were *in crypto* and thus not completely visible. This tooth underlines the distinctive taxonomic status of the genus within Zegdoumyidae.

Key words: Ypresian/Lutetian; m/3; dental morphology; Southern Africa; Zegdoumyidae; Rodentia.

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Introduction

In a recent publication on the zegdoumyid rodents from Black Crow, Namibia, Pickford (2018) erected a new genus and species, *Tsaukhaebmys calcareus*. The available lower molars of the species were either heavily worn or broken (m/2) or were partly hidden within the crypt in the mandible (m/3). Thus it was not possible to provide a complete description of the mandibular dentition.

Additional samples of limestone from the type locality were collected in May, 2018, and were treated in the usual manner with 7% formic acid without buffer. A well-preserved right m/3 of *Tsaukhaebmys* was extracted from the limestone, and comprises the subject of this brief communication.

The specimen underlines the distinctiveness of the genus among known Zegdoumyidae, especially in the subtle to cryptic form of the anteroconid and mesoconid, the absence of the mesostylid and the presence of a small basal cusplet in the ectoflexid.

Geological context, age and associated fauna

The geology of the Black Crow limestone has been described on several occasions (Pickford *et al*. 2008a, 2008b; Pickford, 2015) and a résumé of the geology, age and faunal association of the locality was published by Pickford (2018).

Dental nomeclature

The lower third molar is in an excellent state of preservation, which permits a clear idea of the morphology of the crown to be obtained. The nomenclature of the cusps, cristids and basins employed in this paper (Fig. 2) is based on the system of Marivaux *et al*. (2004, 2014) (Fig. 1) with certain modifications.

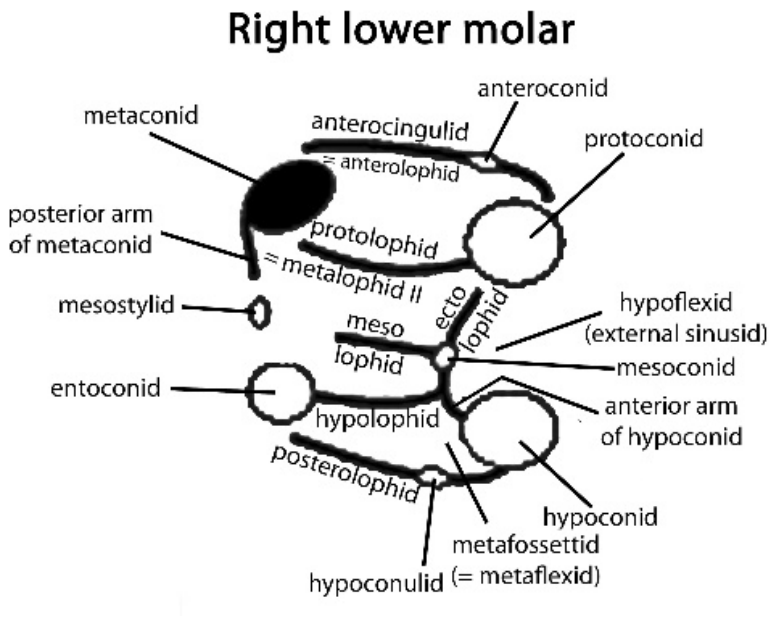

Figure 1. Nomenclature of right lower molar of Zegdoumyidae modified from Marivaux *et al*. (2014).

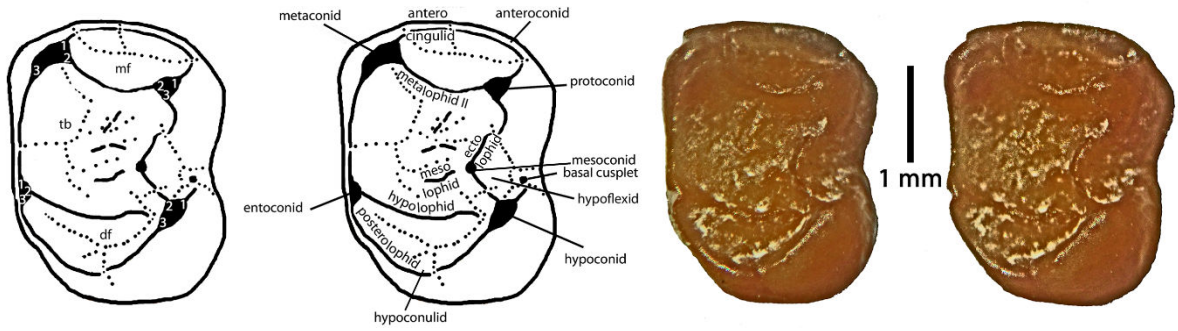

Figure 2. Nomenclature of right lower third molar based on GSN BC Tc 1'18, from the Ypresian/Lutetian limestone of Black Crow, Namibia, and stereo occlusal view of the crown. 1, 2, 3 correspond respectively to the pre-, endo- and post-cristids of each main cusp. Note that the endocristid of the hypoconid (2) is considered by Marivaux *et al*. (2014) to be the anterior arm of the hypoconid; mf - mesial foveid (or fossettid), tb - talonid basin, df - distal foveid (or metafossettid in the nomenclature of Marivaux *et al*. 2014) (scale : 1 mm).

The nomenclature of rodent cheek teeth has varied a great deal (Wood, 1962) especially that of families with highly derived molars containing additional lophs, crests, tubercles and fossettes such as those of murids (Lindsay, 2017) anomalurids (Marivaux *et al*. 2014) and diamantomyids (Lavocat, 1973). There is still debate about the naming of the anteroconid (is it a neoformation, Wood, 1962, or is it a buccally positioned paraconid, Schaub, 1953). The fact that the anteroconid in *Tsaukhaebmys* is barely distinguishable from the anterior cingulum and is close to the mesial end of the preprotocristid, weakens the hypothesis that it is a remnant of a paraconid in an unusal position for this cusp.

Marivaux *et al*. (2014) named the lophid that joins the protoconid to the metaconid the « metalophid II » and gave alternative names for the same ridge as « protolophid » and « posterior arm of the protoconid ». However, if anything, the ridge is contiguous with the endoprotocristid (2 in Fig. 2) whereas the posterior cristid of the protoconid (3 in Fig. 2) is short and steep, extending distally towards the mesial end of the ectolophid.

The distal foveid to the rear of the hypolophid was called the « metafossettid » by Marivaux *et al*. (2014) which seems counter-intuitive because it is nowhere near the metaconid.

Finally, Marivaux *et al*. (2014) called the endohypocristid (2 in Fig. 2) the « anterior arm of the hypoconid ». However, the anterior cristid of the hypoconid (1 in Fig. 2) is short and steep, descending mesiobuccally to form the posterior wall of the hypoflexid.

In front of the hypoconid there is a small low tubercle in the same position as the accessory cusplet that in murids is known as cv1 (Lazzari *et al*. 2010) or as c2 (Knitlová & Horáček, 2017) or as the postero-buccal cusplet (Reed, 2011) or the ectostylid (Lindsay, 2017). Despite their similar positions relative to the hypoconid, these cusplets are probably not homologous, but likely evolved independently in zegdoumyids and murids.

Because of these conflicting or counter-intuitive names, the nomenclature illustrated in Fig. 2 is employed in this paper.

Systematic Palaeontology

Order Rodentia Bowdich, 1821

Family Zegdoumyidae Vianey-Liaud, Jaeger, Hartenberger & Mahboubi, 1994

Species *Tsaukhaebmys calcareus* Pickford, 2018

Diagnosis.- see Pickford (2018).

New material.- GSN BC Tc 1'18, right m/3.

Description

The new specimen from Black Crow is an unworn left m/3, which measures 2.9 x 2.1 mm (length x breadth). The hypoconid is the largest cusp, followed by the protoconid, then the metaconid and a diminutive entoconid. Each cusp has three crests descending from the apical area, as described by Pickford (2018) (numbered 1 : pre-, 2 : endo- and 3 : post- (Fig. 2)). The preprotocristid and premetacristid are steep and descend towards the anterolophid and anteroconid respectively. There is a subtle gap between the anterocingulid and anteroconid, but with slight wear it would no longer be discernible.

The endoprotocristid and endometacristid (2 in Fig. 2) slope towards the centre line of the tooth forming the metalophid II, which comprises a tall wall between the mesial foveid (or fossettid) and the vast talonid basin in the centre of the crown.

The postprotocristid descends towards the ectolophid, and the postmetacristid descends directly distally towards the preentocristid which it meets in a low col forming a lingual opening for the talonid basin. There is no sign of a mesostylid.

The prehypocristid descends buccally and stops just before a low, small basal tubercle (basal cusplet in Fig. 2). The endohypocristid (i.e. anterior arm of the hypoconid in the scheme of Marivaux *et al*. 2014) descends steeply towards the ectolophid which forms a curved wall between the hypoflexid buccally and the talonid basin lingually. The mesoconid is very small, forming a slight swelling in the ectolophid. The posthypocristid is long and swollen, descending disto-lingually towards the hypoconuid and posterolophid, from which it is separated by a narrow, shallow slit, which would soon disappear with wear.

The preentocristid descends steeply anteriorly ending at the base of the postmetacristid, forming a low lingual wall of the talonid basin. The endoentocristid runs across the tooth towards the hypoconid, forming the hypolophid, which it does not join, being separated from it by a short gap. The hypolophid forms a wall which separates the talonid basin from the distal foveid (metafossetid in Marivaux *et al*. 2014). The posterolophid, hypoconulid and post-hypocristid form a continuous C-shaped wall at the rear of the crown. The distal foveid (metafossettid) in this m/3 is substantially larger than that in the m/2 (Pickford, 2018, fig. 2) which is more mesio-distally compressed.

The floor of the talonid basin is slightly rugose, with three poorly formed irregular ridges, comprising the mesolophid opposite the mesoconid and two short, indistinct, ones between the mesolophid and the metalophid II.

The roots are missing, probably not formed at the time that the individual died.

Discussion

The unworn zegdoumyid m/3 from Black Crow, Namibia, shows the morphology of the cusps, crests and foveids clearly. There is no mesostylid, and the mesoconid is diminutive, being little more than a slight swelling where the anterior and posterior arms of the ectolophid meet each other.

Unlike *Zegdoumys* (Marivaux *et al*. 2014) in *Tsaukhaebmys* the hypolophid does not join the hypoconid or the ectolophid, but is contiguous with the entoconid. There are other differences between these genera : the mesolophid does not join the mesoconid and the anteroconid and hypoconulid are really diminutive, barely distinguishable from the anterolophid and posterolophid respectively, their junctions with the lophids marked by narrow, shallow slits which would soon be obliterated by wear.

A result of the reduction of the minor cusplets in this tooth is that the topography of the crown is dominated by the protoconid, metaconid and hypoconid (the largest cusp) and a small entoconid which together surround a vast talonid basin, bordered by tall walls anteriorly and posteriorly (metalophid II and hypolophid respectively) which separate it from the mesial foveid (trigonid basin) mesially and the distal foveid distally.

Unlike other zegdoumyids, the m/3 of *Tsaukhaebmys calcareus* shows a small, low basal cusplet near the rear of the base of the hypoflexid.

Overall, the lower molars of *Tsaukhaebmys* have simpler crown morphology than other described genera of Zegdoumyidae (Marivaux *et al*. 2011, 2014; Vianey-Liaud *et al*. 1994). It remains to be determined whether the simple morphology seen in *Tsaukhaebmys* represents the ancestral condition for the family, or whether it is a secondary simplification of a more complicated ancestral condition.

The overall morphology of the lower molar of *Tsaukhaebmys* accords with the general mammalian tribosphenic pattern, but with a reduced paraconid (= ?anteroconid) and a large hypoconid and small hypoconulid. As such the tooth is quite primitive within the context of rodents, being much simpler in basic morphological elements than the molars of Anomaluridae, for example (Marivaux *et al*. 2014; Vianey-Liaud *et al*. 1994).

As such, the Zegdoumyidae occupy a relatively basal phylogenetic position among African rodents, only exceeded by the reithroparamyid genus *Namaparamys* (Mein & Pickford, 2018).

Conclusions

An unworn lower third molar of *Tsaukhaebmys calcareus* from the type locality, Black Crow, Namibia, yields interesting information concerning details of the morphology of the cusps, cusplets, crests and occlusal basins of this zegdoumyid rodent.

It suggests that, within a rodent context, zegdoumyids are relatively primitive, but not as plesiomorphic as reithroparamyids, for example, which do not possess a protolophid (Mein & Pickford, 2018).

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References

Bowdich, T.E. 1821. *An Analysis of the Natural Classification of Mammalia for the Use of Students and Travellers*. Paris, J. Smith, 115 (+31) pp.

Knitlová, M. & Horáček, I. 2017. Genus *Apodemus* in the Pleistocene of Central Europe: when did the extant taxa appear? *Fossil Imprint*, **74** (**3-4**), 460-481. Praha. ISSN 2533-4050 (print), ISSN 2533-4069 (on-line).

Lavocat, R. 1973. Les rongeurs du Miocène d'Afrique orientale. *Mémoires et Travaux de l'Institut de Montpellier, Ecole Pratique des Hautes Etudes*, **1**, 1-284.

Lazzari, V. Aguilar, J.P. & Michaux, J. 2010. Intraspecific variation and micro-macro-evolution connection: illustration with the late Miocene genus *Progonomys* (Rodentia, Muridae). *Paleobiology*, **36**, 641-657.

Lindsay, E. 2017. *Democricetodon fejfari* sp. nov. and replacement of Cricetidae by Muridae in Siwalik deposits of Pakistan. *Fossil Imprint*, **73** (**3-4**), 445-453. Praha. ISSN 2533-4050 (print), ISSN 2533-4069 (on-line).

Marivaux, L. Vianey-Liaud, M. & Jaeger, J.-J. 2004. High-level phylogeny of early Tertiary rodents : dental evidence. *Zoological Journal of the Linnaean Society*, **142**, 105-134.

Marivaux, L. Adaci, M. Bensalah, M. Gomes Rodrigues, H. Hautier, L. Mahboubi, M. Mebrouk, F. Tabuce, R. & Vianey-Liaud, M. 2011. Zegdoumyidae (Rodentia, Mammalia), stem anomaluroid rodents from the early to middle Eocene of Algeria (Gour Lazib, Western Sahara): new dental evidence. *Journal of Systematic Palaeontology*, **9**, 563-588.

Marivaux, L. Essid, E.M. Marzougui, W. Khayati Ammar, H. Merzeraud, G. Tabuce, R. & Vianey-Liaud, M. 2014. The early evolutionary history of anomaluroid rodents in Africa: new dental remains of a zegdoumyid (Zegdoumyidae, Anomaluroidea) from the Eocene of Tunisia, *Zoologica Scripta*, **44**, 117-134.

Mein, P. & Pickford, M. 2018. Reithroparamyine rodent from the Eocene of Namibia. *Communications of the Geological Survey of Namibia*, **18**, 38-47.

Pickford, M. 2015. Cenozoic Geology of the Northern Sperrgebiet, Namibia, accenting the Palaeogene. *Communications of the Geological Survey of Namibia*, **16**, 10-104.

Pickford, M. 2018. New Zegdoumyidae (Rodentia, Mammalia) from the Middle Eocene of Black Crow, Namibia : taxonomy, dental formula. *Communications of the Geological Survey of Namibia*, **18**, 48-63.

Pickford, M. Senut, B. Morales, J. & Sanchez, I.M. 2008a. Fossiliferous Cainozoic Carbonates of the Northern Sperrgebiet. *Memoir of the Geological Survey of Namibia*, **20**, 25-42.

Pickford, M. Senut, B. Morales, J. Mein, P. & Sanchez, I.M. 2008b. Mammalia from the Lutetian of Namibia. *Memoir of the Geological Survey of Namibia*, **20**, 465-514.

Reed, D.N. 2011. New murid (Mammalia, Rodentia) fossils from a late Pliocene (2.4 Ma) locality, Hadar A.L. 894, Afar Region, Ethiopia. *Journal of Vertebrate Paleontology*, **31** (**6**), 1326-1337.

Schaub, S. 1953. La trigonodontie des rongeurs simplicidentes. *Annales de Paléontologie*, **39**, 29-57.

Vianey-Liaud, M. Jaeger, J.-J. Hartenberger, J.-L. & Mahboubi, M. 1994. Les rongeurs de l'Eocène d'Afrique Nord-Occidentale (Glib Zegdou (Algérie) et Chambi (Tunisie)) et l'origine des Anomaluridae. *Palaeovertebrata*, **23**, 93-118.

Wood, A.E. 1962. The Early Tertiary Rodents of the Family Paramyidae. *Transactions of the American Philosophical Society*, **52** (**1**), 3-261.