

## [Material report]

## A new specimen of a small dichobunoid artiodactyl from the Eocene Pondaung Formation, Myanmar

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### Introduction

The upper middle Eocene Pondaung Formation of central Myanmar is one of the fossiliferous Paleogene deposits in Southeast Asia. Many mammalian fossils have been reported in the formation (Pilgrim and Cotter, 1916; Colbert, 1938; Tsubamoto *et al.*, 2006, 2011 and references therein). This report describes a new specimen of a small bunoselenodont dichobunoid (Mammalia; Artiodactyla) discovered from the Pondaung Formation. The dichobunoids are a primitive and paraphyletic artiodactyl group (Theodor *et al.*, 2007). They are rare in the Pondaung Formation with limited fossil evidence (Tsubamoto *et al.*, 2003, 2012; Métais, 2006; Métais *et al.*, 2007). Therefore, the new material is worth describing and figuring, although it is only an isolated upper molar. The purpose of this report is to reveal the morphology of the new material. The precise comparisons and discussion on its taxonomy and phylogeny should be based on future discovery of better material.

Dental abbreviations.—**M/m**, upper/lower molars.

### Systematic paleontology

Superfamily Dichobunoidea Turner, 1849

Family, genus, and species indeterminate

Figs. 1, 2B

Material.—NMMP-KU 2182, right M3.

Repository.—Department of Archaeology, Ministry of Culture, Yangon, Myanmar.

Locality.—Pk2 locality, Myaing Township, Magway Division, central Myanmar (Tsubamoto *et al.*, 2006).

Formation and age.—“Upper Member” of the Pondaung Formation; late middle Eocene (Tsubamoto *et al.*, 2011).

Dental measurements.—Length = 6.1 mm; width = 7.4 mm.

Description.—NMMP-KU 2182 is a small right upper molar. The interstitial wear facet exists on the mesial base of the crown, but it does not exist on the distal base, indicating that this specimen is M3. The distobuccal corner of the crown is broken away, so that the presence/absence of the metastyle is unknown. The M3 is rectangular in outline, and its distal part is buccolingually narrower than the mesial part. It is wider than long and shows a bunoselenodont morphology with main cusps of a paracone, metacone, protocone, and metaconule. The hypocone is absent. The paraconule is likely absent, although the protocone is heavily worn. The paracone and metacone are conical/pyramidal. The paracone has a buccal rib, is mesiodistally compressed, and is larger than the metacone. The buccal face of the metacone is flattened. The protocone and metaconule are more selenodont than the paracone and metacone.

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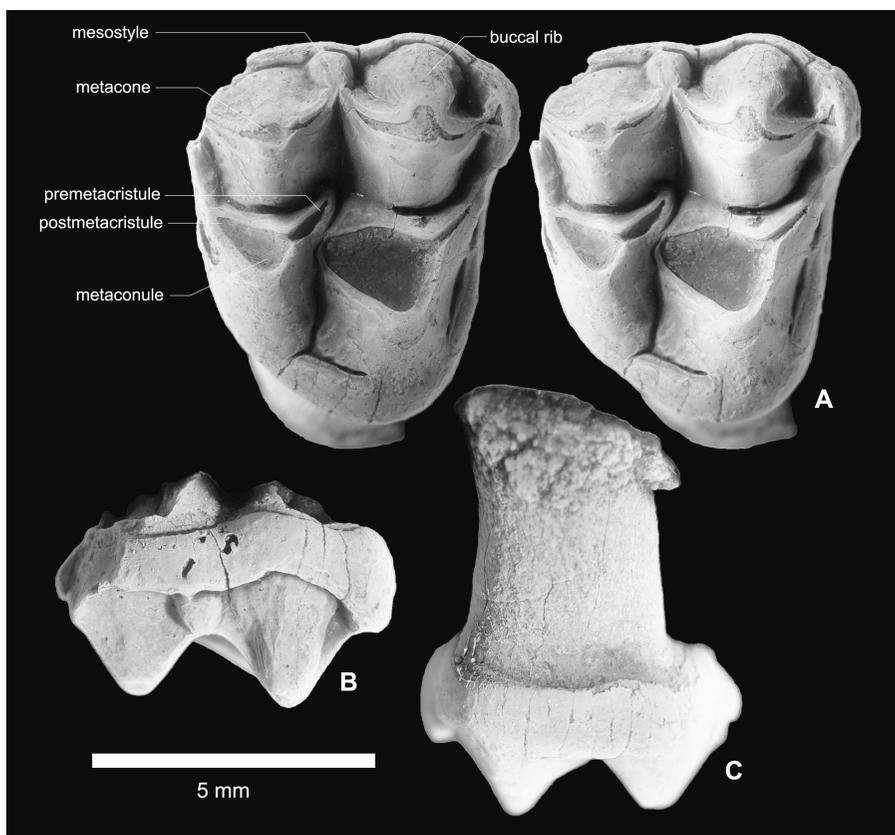


Fig. 1. *Dichobunoidea* indeterminate from the Eocene Pondaung Formation of Myanmar, NMMP-KU 2182, right M3. **A**, occlusal view (stereo pair). **B**, buccal view. **C**, lingual view.

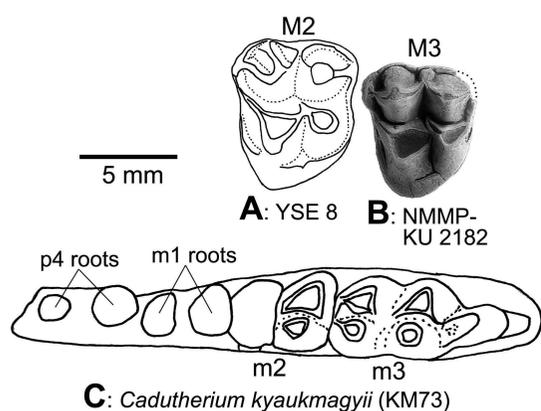


Fig. 2. Comparison of small dichobunoid specimens from the Eocene Pondaung Formation of Myanmar in occlusal view. **A**, YSE 8, left M2 (after Métais, 2006). **B**, NNNP-KU 2182, right M3 (reversed). **C**, KM73 (holotype and only specimen of *Cadutherium kyaukmagyii*), a right mandibular fragment with m3 and a talonid of m2 (after Métais *et al.*, 2007).

The metaconule is smaller than the protocone. The preparacrista extends mesially, linking to the parastyle. The postparacrista and premetacrista extend diagonally, connecting to the mesostyle. The postmetacrista extends distobuccally. The parastyle is located mesial to the paracone on the cingulum. The mesostyle is separated from the buccal cingulum. The preprotocrista extends mesiolingually, linking to the parastyle. The postprotocrista cannot be observed due to wear. The premetacristule extends mesiobuccally and disappears at the mesiolingual base of the metacone. The postmetacristule extends distobuccally. The buccal cingulum is continuous with the parastyle and probably with the postmetacristule, although the distobuccal corner of the crown is broken. The mesial cingulum exists at the mesial base of the protocone. The distal cingulum exists at the distal base of the metaconule. The lingual cingulum exists between the lingual bases of the protocone and the metaconule, lacking the

entostyle. The lingual root consists of one pillar.

### Comparisons and comments

NMMP-KU 2182 (right M3) is very similar in morphology and size to YSE 8 (left M2) described by Métais (2006) from the Pondaung Formation as an indeterminate dichobunoid (Fig. 2 A-B). NMMP-KU 2182 differs only slightly from YSE 8 in having a weaker distolingual cingulum and a slightly more selenodont metaconule, and in lacking an appression facet at the distal margin of the tooth. Another difference between these two specimens is on the buccal rib of the paracone (Fig. 2A-B). In YSE 8, the buccal rib of the paracone is obliquely oriented in buccal view (Métais, 2006), whereas in NMMP-KU 2182, it is not obliquely oriented (Fig. 1A-B). These differences can be explained by the difference of the tooth class (M3 vs. M2). Therefore, NMMP-KU 2182 and YSE 8 likely belong to the same species. In Métais (2006), YSE 8 is only figured by a line drawing, and its precise morphology cannot be observed. The photos of NMMP-KU 2182 in Fig. 1 show a more precise morphology of the upper molars of the species represented by NMMP-KU 2182 and YSE 8.

Métais (2006) concluded that YSE 8 is assigned to the paraphyletic dichobunoids and is distinguished from the known genera of the primitive bunoselenodont artiodactyls. Additionally, NMMP-KU 2182 and YSE 8 are distinct from the upper molars of other primitive bunoselenodont artiodactyls from the Pondaung Formation except for *Cadutherium* Métais *et al.*, 2007. They are distinguished from a possible homacodontine dichobunoid *Asiohomacodon* Tsubamoto *et al.*, 2003, in being smaller, in having less selenodont cusps, and in lacking a paraconule. They are also distinguished from the primitive ruminants, *Indomeryx* Pilgrim, 1928 and *Thandaungia* Métais, 2006, in having less selenodont cusps, a smaller metaconule, a narrower distal part compared to the mesial part, and a more mesiodistally compressed crown. They further differ from *Thandaungia* in lacking a paraconule (Métais, 2006). They are also distinguished from cf. *Indomeryx cotteri* (NMMP-KU 0025; an upper molar; Tsubamoto *et al.*, 2003) in having a smaller metaconule and a narrower distal part compared to the mesial part. They appear to differ from another primitive ruminant, *Irrawadymeryx* Métais *et al.*, 2007, in having

more bunodont cusps, although *Irrawadymeryx* is represented only by the lower dentition.

Métais *et al.* (2007) described a new genus and species of a small and bunodont/bunoselenodont dichobunoid, *Cadutherium kyaukmagyii*, from the Pondaung Formation. *Cadutherium* is based on one specimen, a right mandibular fragment with m2-m3 (Fig. 2 C). Its upper dentition has been unknown. Therefore, *Cadutherium* is not directly compared with NMMP-KU 2182 and YSE 8, which are upper molars. Nevertheless, *Cadutherium* is comparable in size to NMMP-KU 2182 and YSE 8 (Fig. 2). They are also morphologically comparable to one another in that the cusps of one side (buccal in the upper and lingual in the lower) are bunodont and those of the other side (lingual in the upper and buccal in the lower) are bunoselenodont (Fig. 2). Therefore, the possibility that NMMP-KU and YSE 8 might be the upper molars of *Cadutherium kyaukmagyii* cannot be abandoned. This hypothesis should be tested by discovering better material.

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### References

- Colbert, E. H. (1938) Fossil mammals from Burma in the American Museum of Natural History. *Bulletin of the American Museum of Natural History* **74**, 255-436.
- Métais, G. (2006) New basal selenodont artiodactyls from the Pondaung Formation (late middle Eocene, Myanmar) and the phylogenetic relationships of early ruminants. *Annals of Carnegie Museum* **75**, 51-67.
- Métais, G., Aung Naing Soe, Marivaux, L. and Beard, K. C. (2007) Artiodactyls from the Pondaung Formation (Myanmar): new data and reevaluation of the South Asian Faunal Province during the

- Middle Eocene. *Naturwissenschaften* **94**, 759-768.
- Pilgrim, G. E. and Cotter G. de P. (1916) Some newly discovered Eocene mammals from Burma. *Records of the Geological Survey of India* **47**, 42-77, pls. 1-6.
- Pilgrim, G. E. (1928) The Artiodactyla of the Eocene of Burma. *Palaeontologia Indica, New Series* **13**: 1-39, pls. 1-4.
- Theodor, J. M., Erfurt, J. and Métais, G. (2007) The earliest artiodactyls: Diacodexidae, Dichobunidae, Homacodontidae, Leptochoeridae, and Raoellidae. In: Prothero, D. R. and Foss, S. E. (eds) *The Evolution of Artiodactyls*, pp. 32-58. Johns Hopkins University Press, Baltimore.
- Tsubamoto, T., Egi, N., Takai, M., Shigehara, N., Suzuki, H., Nishimura, T., Ugai, H., Maung-Maung, Chit-Sein, Soe-Thura-Tun, Aung-Naing-Soe, Aye-Ko-Aung, Tin-Thein, Thaung-Htike and Zin-Maung-Maung-Thein (2006) A summary of the Pondaung fossil expeditions. *Asian Paleoprimatology* **4**, 1-66.
- Tsubamoto, T., Egi, N., Takai, M., Thaung-Htike and Zin-Maung-Maung-Thein (2012) Dental morphology of an enigmatic artiodactyl from the Eocene Pondaung Formation, Myanmar. *Journal of Fossil Research* **45**, 6-10.
- Tsubamoto, T., Soe Thura Tun, Egi, N., Takai, M., Shigehara, N., Aung Naing Soe, Aye Ko Aung and Tin Thein (2003) Reevaluation of some ungulate mammals from the Eocene Pondaung Formation, Myanmar. *Paleontological Research* **7**, 219-243.
- Tsubamoto, T., Zin-Maung-Maung-Thein, Egi, N., Nishimura, T., Thaung-Htike and Takai, M. (2011) A new anthracotheriid artiodactyl from the Eocene Pondaung Formation of Myanmar. *Vertebrata Palasiatica* **49**, 85-113.
- Turner, H. N. (1849) On the evidences of affinity afforded by the skull in the ungulate Mammalia. *Proceedings of the Zoological Society of London* **17**, 147-158.