

Note about new Pleistocene faunal remains from Tham Prakai Phet, Chaiyaphum Province, Thailand

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Abstract

New mammal fossils from the Tham Prakai Phet have been collected during cave explorations, between December 2011 and January 2012, carried out by a team from Mahasarakham University and the Natural History Museum of the National Science Museum of Thailand. The Tham Prakai Phet (the cave of glittering diamonds), is a karstic cavity formed in Permian dolomitic limestone, located in the Chaiyaphum Province (Northeast Thailand). Here we report the new discoveries, with the description of fossil materials of newly discovered taxa. Our study reveals a more diverse faunal assemblage preserved in the cave. The faunal association is comparable to that one described at Tham Wiman Nakin. Some considerations about the taphonomic processes that occur in the cavity and the possible age of the faunal remains are proposed.

Keywords: Thailand, Pleistocene, mammals, cave, taphonomy

Introduction

This paper describes new material gathered from the Tham Prakai Phet (ถ้ำประกายเพชร, the cave of glittering diamonds), during surveys in Chaiyaphum province in December 2011 and January 2012. The cavity was explored by a team composed of members from the PRC (Palaeontological Research and Education Centre) of Mahasarakham University, and the NHM (Natural History Museum) of the National Science Museum. Some mammal's teeth were collected on the ground in the distal part of the cave. The collection is composed of 101 remains mostly represented by teeth fragments. This cave was discovered by the "Mission Paléontologique Française en Thaïlande", at proximity of Tham Wiman Nakin, which yielded numerous mammal teeth^{1,2,3} and one human tooth attributed to *Homo* sp.³ and dated about 169 ka ± 11 ka, using Uranium/Thorium analysis on teeth and calcite^{4,5}. Some mammal teeth from Tham Prakai Phet (carnivore and herbivore) were provided by a monk (no excavation works have been made) and have been studied by Tou-

gard¹, who identified *Crocota crocuta ultima*, *Rhinoceros sondaicus*, *Bos sauveli*, *Sus* cf. *barbatus*, *Axis porcinus*, *Cervidae* indet., *Muntiacus muntjak*, *Naemorhedus sumatraensis*.

Location

Tham Prakai Phet (16° 29'03" N, 101° 47'9" E) is located in the Khon San District (Chaiyaphum Province) in the Northeastern part of Thailand (Figure1). It is a karstic cavity, developed in a north-south direction and formed in Permian dolomitic limestone and filled with brown concrete clay. The cave entrance lies at an elevation of 580 m, about 20 m above the surrounding alluvial plain. A large quantity of sediments was removed in the proximal part by monks, and a tiled floor was built. The cave is always occupied by a monk.

Palaeontological study

Here we describe the new material using only the most complete teeth.

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Carnivora Bowdich, 1821

Family: Ursidae Fisher, 1817

Genus: *Ursus* Linnaeus, 1758

Ursus thibetanus Cuvier, 1823

An isolated lower carnassial of *Ursus thibetanus* was collected (Figure 2f). The shape of this lower first molar is long and narrow with a deep notch separating the trigonid and the talonid. The trigonid is triangular and larger in length than the talonid. The protoconid is well developed and more anterior than the metaconid. On the lingual face the cingulum is well marked. Pleistocene specimens show the same characteristics as their modern counterparts. The tooth dimensions (Table 1) do not show marked differences with those of modern and fossil specimens, *U. thibetanus* from Tham Lod⁶, Lang Trang⁷, Tham Wiman Nakin¹, Tam Hang⁸ and Yenchingkou⁹. The lower m1 shows same dimensions and morphological similarity with recent and fossil specimens. In the absence of clear characteristics that could confidently characterise the *U. thibetanus kokeni* subspecies, we place the specimen in *Ursus thibetanus*.

Perissodactyla Owen, 1848

The presence of Perissodactyla was mentioned by Tougard¹ in the Tham Prakai Phet assemblage. Two rhinoceros teeth were identified, an upper molar fragment and a lower third right premolar attributed to *Rhinoceros sondaicus*. In this new assemblage, no tapirs or rhinoceros remains have been discovered. Some teeth fragments with very large enamel might suggest fragments of rhinoceros or tapir teeth but the poor preservation do not permit to conclude.

Artiodactyla Owen, 1841

Family: Suidae Gray, 1821

Genus: *Sus* Linnaeus, 1758

Sus scrofa Linnaeus, 1758

Six remains have been collected: a right fourth upper premolar, a right third upper molar and four fragments. Only the P4 is complete. The third molar is broken and little worn and conserved the hypoconid, the metaconid and the talonid, accessory cusps are present on the labial side. The upper right fourth premolar is well molarized (Figure 2g), has a triangular outline merging

the paracone, metacone and protocone together. The dimensions (Table 1) fall within the size range of *Sus barbatus* from Tham Wiman Nakin¹ and of the range of *Sus scrofa* from Du'U'Oi¹⁰. *Sus barbatus*, and *Sus scrofa*, are morphologically similar to each other, and making a distinction between the two species is sometimes difficult. The shape of the crown is circular for the medium size suid (*Sus scrofa*) and quadrangular for the big size suid (*Sus barbatus*)¹. The tooth of Tham Prakai Phet exhibits a triangular shape. The enamel is smooth and not ridulated, like in *S. barbatus*¹. The characteristics of the well preserved specimens, justify attribution to *Sus scrofa*.

Family: Bovidae Gray, 1821

Genus: *Bubalus* Hamilton Smith, 1827

cf. *Bubalus*

A fragmented left lower third molar only preserved by the second lobe is assigned to *Bubalus*. No second interlobar pillar is present. The hypoconid and entoconid are massive and voluminous. The width of the lobe is larger than *Bos* species.

Family: Bovidae Gray, 1821

Genus: *Bos* Linnaeus, 1758

Bos javanicus d'Alton, 1823

One left first lower molar (Figure 2c) presents on the lingual view an entostylid inclined and converged towards the entoconid at the base of the tooth, the parastylid is present but not observable and the metastylid is absent. The metaconid and entoconid are subparallel and delimit a lingual gutter with a very flared U shape. On the occlusal face the ectostylid is developed from the posterior lobe. The groove at the front of the protoconid is rather marked compare to that on the hypoconid. The hypoconid is wider at the base of the crown. The tooth is narrower than the Tham Wiman Nakin specimens¹.

An isolated right deciduous lower tooth (dp4) in an early stage of wear is identified. The first and third lobes are more transversely stretched than the second lobe. In occlusal view, an oval enamel island between the first and the second lobe is present. In labial view, two interlobar columns from the base enclose the protoconid. The distal one is more developed than the proximal one. In lingual view the conids present marked relief, the paraconid and

the metaconid are straight, but the entoconid shows a small forward curvature. The parastyle and the entostyle are protruding and well developed; the metastylid is developed from the middle to the top of the crown. The mesostyle is less developed. The characteristics of the tooth are close to *Bos*. We only ascribe a generic identification *Bos* sp.

Family: Bovidae Gray, 1821

Genus: *Naemorhedus* Hamilton smith, 1827
Naemorhedus sp.

Three upper molars are found closer, and exhibit the characteristic features of a small caprid. They correspond to a left first and third molar and one right second molar of *Naemorhedus*. The left M1 shows an advanced stage of wear. The anterior lobe is wider than the posterior. The anterior lobe is more protruding than the posterior. On the labial face, mesostyle is more pronounced than the parastyle, the metastyle is lightly evident¹¹. Parastyle converges slightly towards the mesostyle at the base. On the occlusal surface two central islands of enamel are present. The limit cementum enamel is labially oblique and fairly high. On the lingual face, the cones present a small pinch at the base. The M2 is very similar to the M1. The anterior lobe is wider than the posterior lobe. The parastyle is larger than the mesostyle. The mesostyle is nearly perpendicular to the labial wall. A posterior fold is present at the central fossa of the posterior lobe. On the lingual face the cones present a small pinch at the base. The M3 is slightly worn (Figure 2b). The metastylar wing is undeveloped and straight, which is slightly more developed towards the base. Labial styles are prominent and thin. On the labial wall, the mesostyle is perpendicular and doesn't bend slightly on the anterior lobe like in *Capricornis*. The interstylar surface of the two lobes is equal. The pillars are small. The lobes are wider than long. The teeth dimensions are close to the recent *Naemorhedus*. The teeth are provisionally attributed to *Naemorhedus* sp.

Family: Bovidae Gray, 1821

Genus: *Capricornis* Ogilby, 1836
Capricornis sumatraensis Bechstein, 1799

Three teeth are attributed to *Capricornis*, a left second lower premolar, a right fourth lower premolar and a right second lower molar. The second premolar has a triangular shape, the parastylid and a metaconid are well developed, the entoconid less. The right fourth premolar is heavily worn, with a rectangular shape. Only the well marked constriction corresponding to the grooves which cut the labial and lingual faces can be observed. The lower molar is little worn and the stylids are apparent (Figure 2a). Entostylid and metastylid are less marked in the upper part but the parastylid is well developed over the height of the crown. The conids of the lingual surface are slightly marked. The pillar of the metaconid is shifted distally while the pillar of the entoconid is centered. On the labial face, the protoconid and the hypoconid have a V-shaped with a more flared outline for the hypoconid. The two conids are separated by a deep groove. Teeth dimensions are close to *Capricornis sumatraensis* from Tham Wiman Nakin¹, Szechwan⁹, Sumatra caves¹² and Lang Trang⁷ but bigger than Phom Loang¹³ and recent specimens.

Family: Cervidae Goldfuss, 1820

Genus: *Rusa* Smith, 1827
Rusa unicolor Kerr, 1792

One specimen is attributed to *Rusa unicolor*, a left third premolar. The tooth is broken distally, the entostylid is absent. On the labial face, the tooth shows a small groove between protoconid and hypoconid. The parastylid is well developed and fused to the paraconid in a shallow V-shape. The paraconid is separated from the metaconid by a large groove. Size and characteristics are similar to *Rusa unicolor* premolar.

Family: Cervidae Goldfuss 1820

Genus: *Axis* Hamilton Smith 1827
Axis porcinus Zimmerman 1780

A fragmented right mandible with the lower first and second molar is attributed to *Axis porcinus* (Figure 2d). The m1 shows an anterior goat fold, linked to the parastylid. Hypoconid and protoconid are well developed, salient, directed slightly backwards. The hypoconid has a V-shaped, the protoconid is more rounded. Parastylid is well marked, the metastylid and the entostylid are

undeveloped. A small ectostylid is present. The same characteristics are observed on the m2 with an anterior lobe more developed than the posterior. The dimensions are in the range of size of Tham Wiman Nakin specimens¹ (Table 1).

Family: Cervidae Goldfuss 1820

Genus: *Muntiacus* Rafinesque 1815

Muntiacus sp.

A left second lower molar highly worn is attributed to *Muntiacus*. Considering the tooth wear and the high diversity of *Muntiacus* species in Southeast Asia (*M. muntjak*, *M. truongsongensis*, *M. fea*) we prefer to classify this tooth, as *Muntiacus* sp.

Rodentia Bowdich, 1821

Family: Hystricidae Fischer, 1817

Genus: *Hystrix* Linnaeus, 1758

Hystrix sp.

Ten lower and upper cheek teeth of rodents have been collected; one species has been recognized in the sample. They show the typical occlusal pattern of the family Hystricidae with folds and enamel islands and great dimensions. The isolated teeth are attributed to *Hystrix*. The porcupine has been previously recognized in Tham Wiman Nakin assemblage either as *Hystrix hodgsoni subcristatus*^{2,14} or recently as *H. indica* or *H. kwangsiensis*¹⁵. Due to the lack of a full dental series or skull (for nasal region) and the small size of the sample for each tooth, we cannot conclude accurately about the species. We prefer to assign the teeth to *Hystrix* sp.

Taphonomy

Tooth fragments represent the majority of dental remains, complete teeth are scarcer. Some small splinters of bone difficult to identify were also collected. The teeth fragments conserve dentine and enamel, their size is rarely exceed 2 cm and the aspect is well fossilized; some of them have a rounded aspect. Hydraulic flow can transported and remobilized elements accumulated in karstic network^{16,17,18} and modified the shape and the aspect of the remains^{19,20}, it is well known from fluvial environment^{21,19}. Water circulation is probably one of the main taphonomic agents in the cave. Nevertheless,

biological agents (carnivores and rodents) can also be responsible of the faunal accumulation at Tham Prakai Phet. Although carnivores remains were present in the assemblage (*Ursus thibetanus* and *Crocuta crocuta ultima*), the Asiatic Black Bear is not known as a dense accumulator of prey. On the other hand, the specialized carnivore *Crocuta crocuta* is known to accumulate a large amount of animal remains in his den^{22,23,24}. The mammal assemblage of Tham Wiman Nakin would have been created by the latter¹. The hyena is poorly documented in the assemblage of Tham Prakai Phet only one lower third premolar has been identified¹. Although very few bones have been found, there is no evidence, such as tooth marks, and digested bones, of carnivorous activity. The only biological modification observed, is gnawing marks made by rodents. Three elements wear tooth marks made by rodent incisors, comprising a fragmented mandible of *Axis porcinus*, a bone fragment and a fragmented lower canine of *Sus* sp.. These elements conserved the typical shape of large rodent tooth marks which appear large and shallow. The size and the morphology of the grooves can be identified as gnaw marks made by porcupines^{25,26}. Lot of teeth of this rodent has been found in the cave. Large size rodent are very common in South Asia caves, and they created and modified mammalian assemblages such as Monk Cave²⁷ and Tham Wiman Nakin¹. Although the evidence is sparse, we can hypothesis that rodents are the main agent, responsible for the accumulation of mammals in the cave.

Discussion

The remains have been collected from the ground and no remains have been found in stratigraphic context. The fossiliferous layer has not been yet located, but there is no doubt about the presence of a well preserved Pleistocene mammal assemblage in the distal part of the cave. This study reveals a more diverse mammalian assemblage composed of carnivore, herbivore and rodent species (Table 2). No micromammals have been collected. The new material composed mostly of isolated teeth, significantly increases the faunal list compiled by Tougard¹. Our new collections contain new taxa comprising *Ursus*

thibetanus, *Rusa unicolor*, *Bubalus bubalis*, *Bos javanicus*, *Naemorhedus* sp., *Sus scrofa* and *Hystrix* sp. (Table 2). The faunal assemblage of Tham Prakai Phet can be considered similar to Tham Wiman Nakin, like it was proposed by Tougard¹. The species described in this study are still extant in Thailand. The hyena (*Crocuta crocuta ultima*) is the only extinct taxa present in the assemblage.

Although no absolute datings were performed on teeth or calcite, the mammalian assemblage could have been accumulated during OIS 6. But as the presence of the species found in Tham Prakai Phet, ranges from the Middle Pleistocene to late Pleistocene, is hard to confirm the age for the moment. The proximity of the two caves and their supposed contemporaneity allow proposing an identical paleoenvironment. Tham Prakai Phet can be temporarily classified as a slightly open forested habitat with humid conditions, like Tham Wiman Nakin^{28,29,30}. This study highlights the need for new data to improve our knowledge of the *Stegodon-Ailuropoda* fauna in Southeast Asia. The fossil record for the Pleistocene period is poorly documented. Pleistocene mammal communities are not well defined in Thailand but also in Indochinese province. Future fieldwork will focus on excavating a test pit in the distal part of the cave and the application of stratigraphic analyses. The study of the cave filling will explain the processes of faunal accumulation in the network. The next excavation would provide also more fossil specimens, helpful to better characterise the fauna association and validate the contemporaneity with the Tham Wiman Nakin assemblage, but also proposed a more precise mammalian biostratigraphy of the Pleistocene in this part of Southeast Asia.

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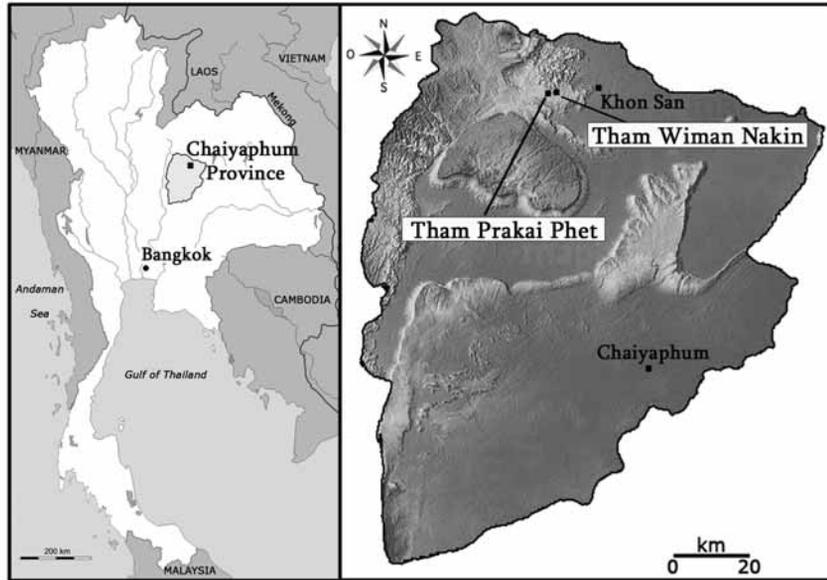


Figure 1 Maps of Thailand with location of the Chaiyaphum Province, and the location of Tham Prakai Phet and Tham Wiman Nakin.

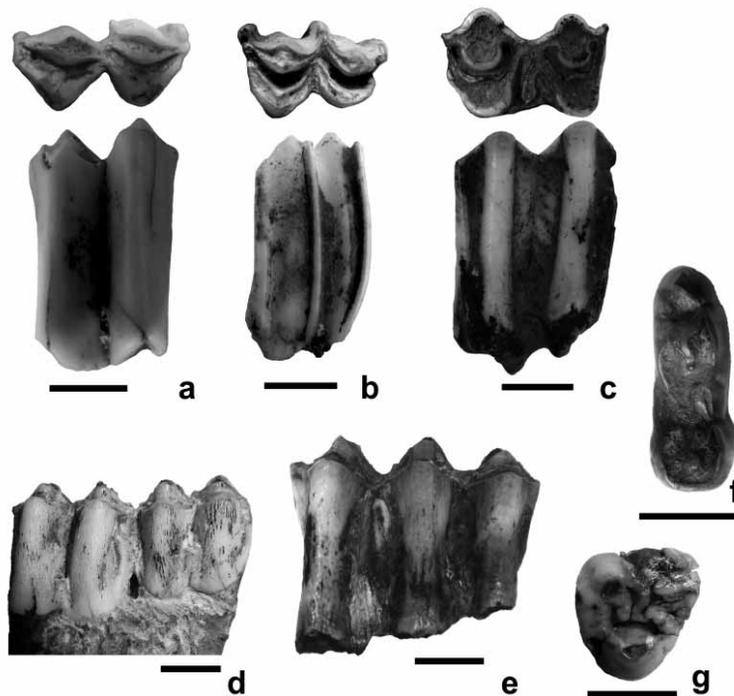


Figure 2 Remains from Tham Prakai Phet: a) *Capricornis sumatraensis*: lower m2; b) *Naemorhedus* sp.: upper M3; c) *Bos javanicus*: lower m1; d) *Axis porcinus*: mandible with m1 and m2; e) *Bos* sp.: lower dp4; f) *Ursus thibetanus*: lower m1; g) *Sus scrofa*: upper right P4 (Scale bar 1 cm).

Table 1 Dimensions of the Tham PraKai Phet well preserved specimens.

| Taxa | Teeth | Laterality | Lenght | Width |
|---------------------------------|-------|------------|--------|-------|
| <i>Ursus thibetanus</i> | m1 | right | 21.7 | 8.7 |
| <i>Sus scrofa</i> | P4 | right | 14.2 | 15.8 |
| <i>Bos</i> sp. | dp4 | right | 35.5 | 15.6 |
| <i>Bos javanicus</i> | m1 | left | 23.3 | 14.7 |
| <i>Naemorhedus</i> sp. | M1 | left | 10.3 | 12.7 |
| | M2 | right | 13 | 14.5 |
| | M3 | left | 17 | 13.8 |
| <i>Capricornis sumatraensis</i> | p2 | left | 8.8 | 7.3 |
| | p4 | left | 15.1 | 9.1 |
| | m2 | right | 20.6 | 13.8 |
| <i>Muntiacus</i> sp. | m2 | left | 12.6 | 9.3 |
| <i>Axis porcinus</i> | m1 | right | 17.3 | 11.7 |
| | m2 | right | 19.3 | 13.8 |

Table 2 Updated faunal list from Tham Prakai Phet.

| Order | Family | Taxa | Common name | Tougaard (1998) | This study |
|----------------|---------------------------------|--------------------------------|--------------------|-----------------|------------|
| Carnivora | Hyaenidae | <i>Crocuta crocuta ultima</i> | Spotted Hyena | + | |
| | Ursidae | <i>Ursus thibetanus</i> | Asiatic Black Bear | | + |
| Perissodactyla | Rhinocerotidae | <i>Rhinoceros sondaicus</i> | Javan Rhinoceros | + | |
| Artiodactyla | Suidae | <i>Sus</i> cf. <i>barbatus</i> | Bearded Pig | + | |
| | | <i>Sus scrofa</i> | Wild Boar | | + |
| | Cervidae | <i>Muntiacus muntjak</i> | Barking Deer | + | + |
| | | <i>Axis porcinus</i> | Hog Deer | + | + |
| | | <i>Rusa unicolor</i> | Sambar | | + |
| | | Cervidae indet | | + | |
| | Bovidae | <i>Bos sauveli</i> | Kouprey | + | |
| | | <i>Bos javanicus</i> | Banteng | | + |
| | | cf. <i>Bubalus</i> | Wild Water Buffalo | | + |
| | | <i>Naemorhedus</i> sp. | Goral | | + |
| | <i>Capricornis sumatraensis</i> | Serow | + | + | |
| Rodentia | Hystriidae | <i>Hystrix</i> sp. | Porcupine | | + |