

Proposed Conservation of Badak Cave C, Lenggong as Vertebrate Fossil Site Extraordinary

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Abstract

Remnants of three extraordinary beds of calcified alluvial sediments containing numerous teeth and bones fossils from a number of species of mainly large herbivorous vertebrate were found in the Badak Cave C in the Lenggong Hills, Ulu Perak. These alluvial beds which appeared to be deposited at slightly different time probably in the Late Pleistocene, represent fillings of the cave floors by sediments brought in by floodwaters. The richness of these fossil remains within the three beds (from 50cm to about 1 metre thick) is extraordinary. One or more catastrophic flood events are believed to have caused the mass death of mainly herbivores trapped in front of the tower limestone hills close to the cave entrance. The remains were then subsequently transported into the cave and deposited with the sandy sediments of granitic origin after another flood. The fossil parts of the large vertebrate consist of mainly teeth and numerous skeleton parts. There could be tens or more of individual vertebrates though identified large herbivore species include seladang (one adult and one juvenile), sambar deer, the bucking deer and probably a young elephant and other herbivores and a civet cat. Because of its richness in fossil bones and teeth and its unique occurrence, it is proposed that the Badak C cave with its fossil remains be studied systematically in detail and be preserved and gazetted as a Geological Site of Special Scientific Interest. By itself it shows good potential for attracting tourist and in conjunction with the Paleolithic Kota Tampan and the nearby epi-paleolithic Perak Man site, can form an archeological-geological eco-tourist complex of great significance for Malaysia.

Cadangan Pemuliharaan Gua Badak C, Lenggong Sebagai Tapak Fosil Vertebrata Yang Luar Biasa

Abstract

Ketinggalkan tiga peralapisan luar biasa daripada sedimen aluvium berkalsik terdiri daripada beberapa spesies fosil gigi dan tulang yang kebanyakannya vertebrata herbivor besar boleh dijumpai dalam Gua Badak C di Perbukitan Lenggong, Ulu Perak. Peralapisan aluvium yang dianggap terendap pada perubahan masa singkat pada Akhir Pleistosen, mewakili bahan pengisi lantai gua oleh sedimen yang dibawa oleh air banjir. Kelimpahan fosil yang tinggi dalam ketiga-tiga peralapisan (daripada 50 cm ke 1 meter tebal) adalah sangat luar biasa. Satu atau lebih kejadian banjir katastrofik dipercayai menyebabkan kematian herbivor secara besar-besaran yang terperangkap di depan menara bukit batu kapur berdekatan dengan mulut gua. Baki yang tertinggal kemudiannya diangkut ke dalam gua dan diendapkan oleh sedimen berpasir jenis bergranit hasil daripada banjir yang lain. Bahagian fosil vertebrata besar terdiri terutamanya daripada gigi dan tulang rangka. Terdapat sepuluh atau lebih individu vertebrata dikenalpasti, dengan spesies herbivor seperti seladang (satu matang dan satu muda), rusa sambar, rusa 'bucking', mungkin anak gajah dan seekor kucing 'civet'. Disebabkan kelimpahan fosil tulang dan gigi dan kejadian yang unik, adalah dicadangkan Gua Badak C dan tinggalan fosil dikaji dengan terperinci secara sistematik dan dipelihara dan seterusnya diwartakan sebagai Tapak Geologi Berkepentingan Saintifik Khas. Ia juga mempunyai daya tarikan pelancong dan seiring dengan Paleolitik Kota Tampan dan epipaleolitik tapak Perak Man berdekatan boleh membentuk kompleks arkeologi-geologi eko-pelancongan yang penting bagi Malaysia.

CAVES OF LENGGONG

The limestone hills of Lenggong, in the upper Sungai Perak basin, form several medium to small size cone-shaped mogote hills located from 1 to 4 km towards the north of Lenggong town. There are altogether 6 small to medium size limestone hills in which numerous caves were found (Figure 1). These caves are located at various levels from the present alluvial plain. These caves consist of short-length allogenic water source types as well as large and more complex vadose and groundwater level cave systems. In view of the presence of a palaeolithic community in the Lenggong (Zuraina *et al.*, 1994), a

number of these caves are important archeological sites, for example, Gua Gunung Runtuh where the Perak Man was buried and discovered in 1990. Gua Badak C is one of several small caves given the same name which are located inside an irregularly shaped N-S elongated limestone hill about 5 km NNE of Lenggong town (Figure 1).

GEOLOGY OF LENGGONG

The Lenggong area is composed of small lenses (9 km long x 2 km wide) of calcareous facies rock with minor argillaceous components belonging to the Keroh Formation, which is of the Lower Paleozoic Age (Rushdan, 1994,

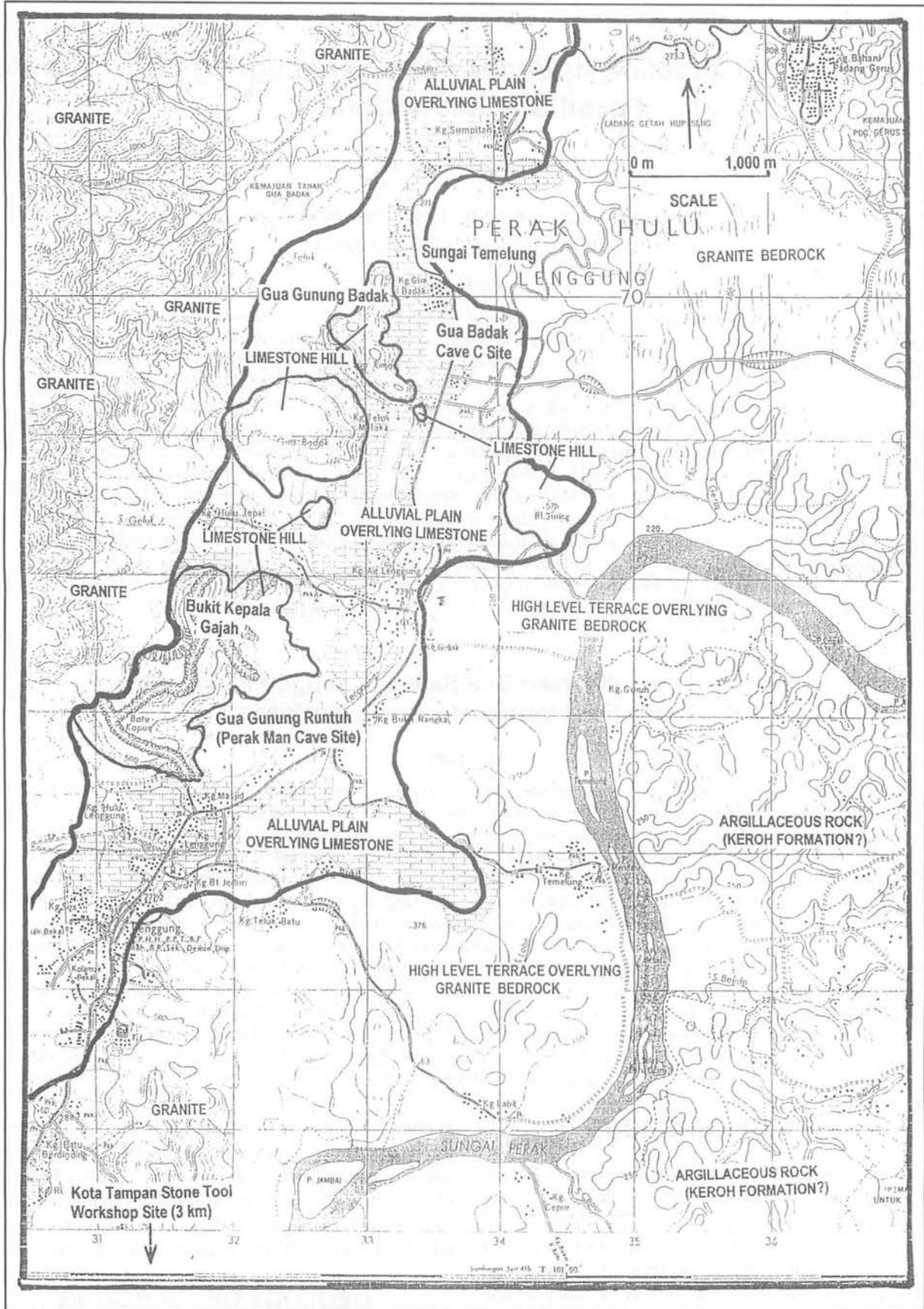


Figure 1: Regional Geology and Location of The Badak Cave C.

Figure 1). During Late Triassic, the Keroh Formation rocks were intruded by coarse-grained porphyritic biotite granite that is regarded as part of the Bintang Range Granite (Yap, 1969). The calcareous rocks were metamorphosed to form fine to medium-grained banded white to light gray marble that are cut by veins and masses of calc-silicate hornfels. Most parts of the marble had been planed through successive phases of corrosive erosion and it is upon this planation surface that alluvial sediments were deposited probably from 500,000 to 70,000 BP. The 6 limestone mogote hills that rise above the flat alluvial plain are remnants of the planation phase which are not buried by the alluvial sediments.

CAVE MORPHOLOGY OF GUA BADAK C

The Badak Cave C is small cave with an east opening on the N-S face of the eastern wall of the Gunung Badak. It measures about 70 m long and at its broadest is about 20 m wide (Figure 2). Its main axis in the N-S direction is composed of an intermediate level water table / allogenic-water-source elongated cavity with several bell-shaped chambers that are of vadose origin and they are controlled along mainly 240° fracture zones. Many of these larger chambers (up to 19.5 m high from the main cave floor) have swallow holes that open on the same eastern wall face as the cave entrance. The water table/allogenic-water-source chamber shows a smooth to curved roof, which is mainly free of speleothems. A narrow second level allogenic-water-source chamber runs about 4 m above and towards the east of the main intermediate level chamber.

Speleothems are mainly stalactites and these are mainly deposited along bell-shaped and narrow inclined chambers that have been carved out by vadose action along largely 240° or N-S fractures. Stalagmites are of lesser importance and are located at a few places where very strong growth of stalactites are found, especially at the northern appendage cave chamber. This appendage has a westward sloping cave floor and overall this cave floor is about 2 m to 3 m higher than the cave entrance opening. Cave pearls that required a calm condition for its deposition are found at several locations on the present cave floor especially along the southern half of the cave chamber above which the fossil beds are located. Ford and Williams (1989) are of the opinion that the growth of these calcite pearls requires gentle agitation of the shallow water pools on the cave floors by falling drops of feedwater.

The cave floor slopes down 1 m to 2 m towards the south from the entrance level. It steps down a further 1 m at the southwestern appendage. The cave does not have a level opening at the southern end. This opening could have been a downward vadose connection that is now blocked or covered up by the cave sediments.

THE VERTEBRATE FOSSIL BEDS

Findings of fossil parts of vertebrate mammal in limestone caves have hitherto not been reported in Malaysia

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though archeological diggings in caves have recovered many vertebrate bones and teeth of many animals which were believed to have been used as food by human communities or have died inside the caves. Among the caves that had been excavated are Niah Caves in Sarawak, Gua Cha in Kelantan, Gua Kecil in Pahang and Gua Gunung Runtuh and Gua Telok Kelawar in Lenggong Perak (Davison, 1994; Davison *et al.*, 1987). The only fossil vertebrate that are known to the writers is that of “Naga Mas” where a “whole” skeleton of a large vertebrate was exposed on the travertine wall in a short cave located at about 30 m high in a small hill of Gunung Lanno. Members of the Malaysian Nature Society first discovered this site. However, until now, the identity of this well preserved fossil (either a bear or a tiger) is not known (Tjia, 1993). Another mammal fossil of importance that has been found in the alluvial sediments in the Kinta Valley and reported widely is the discovery of the *Elephas maximus* teeth (the modern day elephant) in Chemor and the *Elephas namadicus* teeth in Salak (Andrews, 1905; Savage, 1937, and Ingham and Bradford, 1960). The *E. namadicus* arrived in this part of the world between 30,000 to 15,000 years ago and is now extinct.

One of us (Ros Fatimah) was the first to hear of the presence of some “gajah” bones sticking out from the cave walls of a small cave which had been previously examined by Prof. Zuraina’s archeological team from Universiti Sains Malaysia, Penang. Arrangement was then made to check this out. Mapping and examination and collection of some of the teeth samples were carried out during the first field visit. Remnants of three beds of fossil bearing calcified alluvium were recognized (Figure 2) in the Badak Cave C and the nature of each bed is given below:

Northwest Bed

The highest level bed is located at the northwestern appendage where several remnants of a 60 cm thick calcified sandy alluvial sediments were found. It is more strongly calcified compared to the other two. It is located at about 70 cm above the westward sloping floor that is 2 m to 3 m above the cave entrance level. Here several teeth of large vertebrates are found and these appear to belong to herbivores. Another large teeth with a compound crown has been tentatively identified as belonging to a young elephant (Plate 3).

Centre Bed

This is the best preserved of the three alluvial beds. Remnants of this bed are found sticking onto the chamber walls and limestone pillars from 1.5 m to 2.5 m above the cave floor level. Therefore, this would be about the same level as the cave entrance. The sediment is composed mainly of coarse-angular sand with muscovite (both of granite origin) with a matrix of yellow clay and calcite cement. Locally, some pebble and cobbles of limestone fragments can be found incorporated into the sediments. Localized top parts of this bed are found to contain cobbles

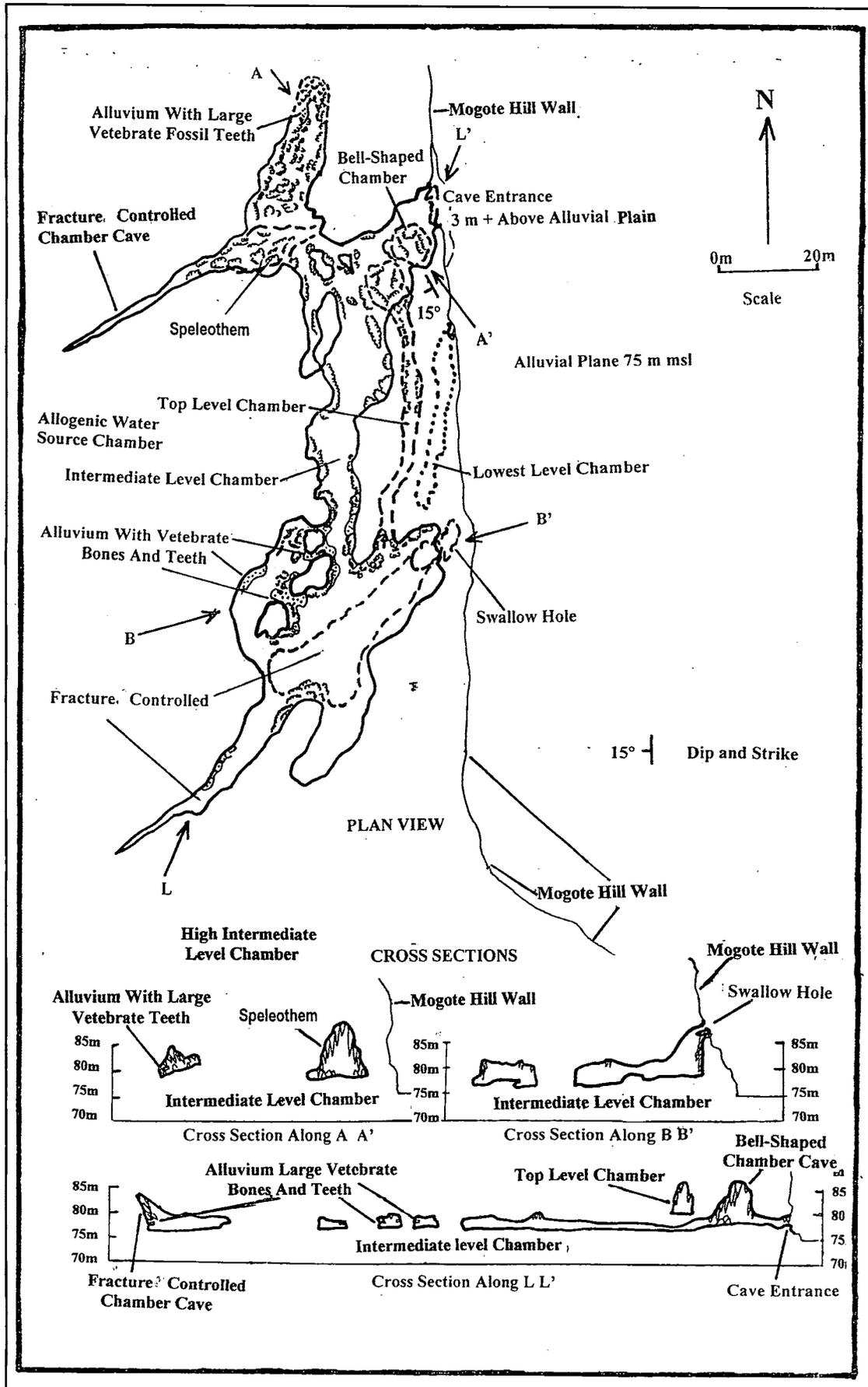


Figure 2: Vertebrate fossil Badak Cave C, Lenggong, Upper Perak.

of weathered granitic rock that have apparently dropped from the vadose connections from the top. The sediments below this remnant bed have been eroded off and the nature of sediment is unknown.

The remnants of this bed is extremely rich in fossil fragments which are composed of randomly distributed teeth and many bone fragments (Plates 1 and 2). The fossil fragments are distributed throughout the bed. A number of large vertebrate long bones that stood out horizontally from the remnant bed (due to differential erosion) were knocked off and taken away by some previous visitors (Plate 2). Some of the teeth are found still stuck inside fragments of jawbones. It is from here that the teeth form the bucking deer, the sambar deer and the civet cat was found (Plate 4).

Samples of the calcified alluvial sediments were dissolved using dilute HCl. The mineral contents of the sediments after dissolving with HCl were identified with the help of a petrographic microscope. The mineral components are largely quartz with some muscovite and clay minerals. No silicic volcanic ash was found in the sediments.

Southwest Bed

The remnant of this calcified alluvial bed is found in the southwestern cave chamber which is about 1 m lower than the cave floor at the centre part of the intermediate level chamber. The remnants are also located at about 1 m above the cave floor and thus would be about 1.5 m lower than that of the Centre Bed. It is about 40 cm to 80 cm thick and contains coarse quartz sand with white mica and cemented by the yellowish clay and calcite. Certain parts of the remnant bed contain large pebble to cobble-size clasts of gray limestone and highly weathered granite. The fossils found consists of teeth and bone fragments. These are found throughout the bed. The molar of the mature seladang (or gaur) is recovered from this bed. Solid cave floor with several generations of cave pearl growth was found at about 100 cm below the bottom of the calcified bed.

IDENTIFIED VERTEBRATES

The fossils that were identified (with the help of Dr. Lim Boon Liat, Hon. Consultant to Perhilitan, Cheras, Kuala Lumpur) with certainty were that from 3 species of herbivores and a civet cat. Based on field photographs, a young elephant is likely to be present also. Numerous other specimen are still to be identified on the spot at the site of the cave. Those identified are:

1. *Bos gaurus* (gaur or seladang). A young and a mature seladang are present. The identification is based on the molar teeth (Plate 5) of the upper jaws of both animal.
2. *Cervus unicolor* (sambar deer). The crown of the molar of the upper jaw is used for this identification (Plate 6).
3. *Muntiacus muntjak* (bucking deer). It is identified

based on the molar of the upper jaw. A lower incisor is believed to be from this bucking deer and could be from the same or a different individual.

4. *Paradoxidus sp.* The only non-herbivore is probably a civet cat that was identified by the lower jaw molar. This animal could have been overwhelmed by the catastrophic flood or could have drowned hiding inside the cave.

During the excavation of Perak Man and the nearby Gua Telok Kelawar, the vertebrate bones and teeth that were found are believed to be parts of the animals used mainly for food. Identification carried out by Davison (1994) indicates the presence of reptiles and mammals which range from bats to primates, porcupine, bamboo rat, civet, wild dog, bear, tiger, wild boar, mouse-deer, tapirs and herbivores like the bucking deer, sambar deer and the seladang. The fossil bones in Badak Cave C are however, deposited by natural geological process and not brought in to the caves by human inhabitants.

THE TAMPANIAN COMMUNITY AND ITS ECOLOGICAL SETTING

The three fossiliferous beds in Badak Cave C represent the remains of what must have been three quite extensive beds of calcified alluvium which had been subsequently eroded by running water which have re-entered the cave after the calcification process. Based on the detailed characteristics of the cave, the history of the cave formation and the deposition of the cave sediments could be deduced. Firstly, the main cave entrance of the cave is slightly over 3 m above the present Sungai Temelung alluvial plain. On this basis, and assuming that at the time of deposition of the fossiliferous beds, the alluvial plain must have been at the same level as the cave entrance. Assuming an average denudation rate of 0.1 mm per year for that of the Kinta Valley (Krahenbuhl, 1991), then the time when the alluvial plain is at the same level as the cave opening floor height is about 30,000 years.

This is the first time that vertebrate fossils are found in such numbers in a limestone cave in Peninsular Malaysia. In Thailand, fossil vertebrates have been commonly found in a number of caves and they have been dated to range up to 200,000 BP. During the Late Pleistocene time the climatic condition had sustained grassland rather than the humid tropical rain forest (Yaowalak, 1998).

Kota Tampan located about 12 km SSW of the Badak Caves has been deduced to be the workshop for the palaeolithic tools for the Tampanian community which had been assigned the age of between 200,000 BP and 500,000 B.P. by Sieveking (1958). However based on more comprehensive studies, Zuraina and Tjia (1988) and Tjia (1993) are of the opinion that the palaeolithic tool workshop at Kota Tampan was active at around 30,000 years ago. They based this on the premise that this Kota Tampan "workshop" site was at the shore of a natural lake that was formed due to several landslides which blocked the Sungai



Plate 1: Cross-section of some long bones exposed on the calcified alluvial sediments (centre bed) which had been broken off by previous visitors. Location: Centre Bed, Badak Cave C.



Plate 2: Fragment of a vertebrae exposed on the calcified alluvial sediment in the centre bed of the Badak Cave C.



Plate 3: Compound crown of teeth of a large vertebrate probably a young elephant. Location: Northwest Bed, Badak Cave C.



Plate 4: Collection of teeth specimen collected from the Centre and the southwestern Beds of Badak Cave C. Top row all from Centre Bed, from right: Molar of young seladang, a molar of sambar deer, crown of molar of bucking deer and incisor of lower jaw of bucking deer. Lower large tooth is the molar of a mature from southwestern bed.



Plate 5: Comparing the large molar tooth of the mature seladang with the teeth on the upper skull of a mature seladang at the Museum Perhilitan, Cheras, Kuala Lumpur. The tooth specimen is from the Southwestern Bed, Badak Cave C.

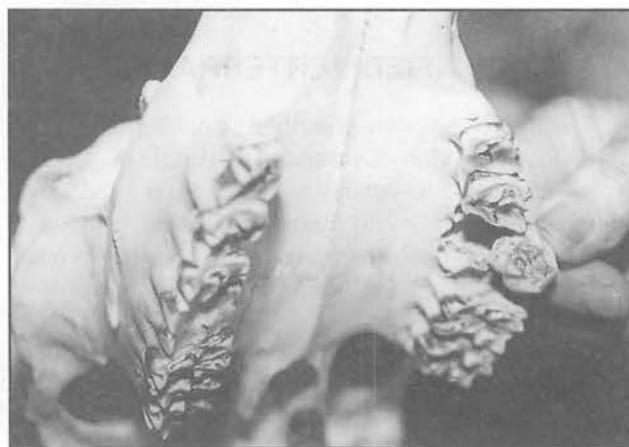


Plate 6: Close-up comparison of the sambar deer molar with the teeth found on the upper jaw of the sambar deer skull at the Museum of Perhilitan, Cheras, Kuala Lumpur. The tooth is from Centre Bed, Badak Cave C.

Perak prior to 30,000 years ago. This lake covered a large area stretching from Suak to Kota Tampan and beyond to Lenggong. The level of this palaeo-Chenderoh lake is deduced by Tjia to be at around the 75 m to 80 m present contour level. The age had been largely determined by the correlation of the presence of the 30,000 BP silicic volcanic ash from a huge Toba eruption which during the time of the eruption had blanketed a large part if not the whole of Peninsular Malaysia. From their studies (Zuraina and Tjia, 1988), the volcanic ash which had been geochemically matched with 30,000 BP Toba ash, is found mixed with the palaeolithic tool horizon and overlying it. It is without doubt, that the formation of the palaeo-Chenderoh lake in this period had allowed the preservation of the volcanic ash in the Lenggong - Kota Tampan area that was eroded off quickly elsewhere.

The absence of the volcanic ash component in the fossiliferous centre bed of Badak Cave C indicates that it is likely that the deposition of this bed has predated the volcanic eruption. The palaeo-Chenderoh Lake could have slowed down the denudation of the alluvial sediments in Sungai Temelung plain. The estimation of the 30,000 years based on denudation is too low. The age of deposition of the fossiliferous bed is thus bracketed between the 31,000 \pm 3000 BP (Stauffer *et al.*, 1980) eruption date of the Toba volcano and the deposition of the alluvial sediments over the planation surface of the limestone prior to 70,000 BP (Ros and Yeap, in press).

The Perak Man of Australomelanesoid racial affinity was discovered in 1990 in Gua Gunung Runtu which is located about 3 km SW of the Badak Cave C. The age of the Perak Man is based on the radiometric age of freshwater shell (presumed burial gifts) which gave it as 10,120 \pm 110 years (Zuraina, 1994). Based on the analysis of the lithic assemblage and other artifacts that was excavated from the Gua Runtu site, Zuraina *et al.* (1994) came to a conclusion that Perak Man is a continuation of 20,000 years (commencing at from 30,000) of the Tampanian culture without much change and the Perak Man is dated culturally as "pre-ceramic epi-Palaeolithic".

Based on the identification of the vertebrates that were excavated from Gua Bukit Runtu and the nearby Gua Telok Kelawar, Davison (1994) is of the opinion that the "Tampanian community" that existed then was largely composed of hunters or gatherers who depended very much upon the animals for food. The presence of dangerous animals like the bear, gaur (seladang) and tiger indicates that the community must have also used other methods of capture such as pitfall traps.

MASS DEATH OF HERBIVORES AND THE FORMATION OF FOSSIL BED

The main animal group of vertebrate animals that were preserved in the three calcified alluvial beds in the Badak Cave C is herbivorous. This probably fits in very well with the geomorphologic and climatic conditions during the

Late Pleistocene. The largely flat areas that are found around the Lenggong can be attributed to the limestone bedrock that had undergone karstification and being planed by many stages of corrosive and weathering phases. It is during about 70,000 to 500,000 BP that a thick sequence of alluvial material was deposited on the limestone planation surface up to ten or more metres above the present alluvial plain level. That the flat areas around Lenggong formed a grass plain is supported by the presence of a drier climatic condition during Late Pleistocene (Verstappen, 1975) and by the evidence from neighbouring Thailand (Yaowalak, 1998). Under such drier climatic condition, it is envisaged that the highland area would be rather bare and it is only in the gentler grass plains that many animals and mostly herbivorous would thrive.

It is envisaged that the present flat and gently sloping areas around Lenggong and stretching south to Kota Tampan (which would be about 3 m higher from the present level) prior to 30,000 BP would have been grassland that supported a large population of herbivores and other animals. It is thus important to note that the existence of a large herbivore population allowed the Tampanian community to thrive successfully in this grass plain as hunters and gatherers for a long period of time (Zuraina *et al.* 1994; Davison, 1994). It is likely that with the coming of the Holocene humid tropical climatic condition, the grassland and hilly areas of the Lenggong - Kota Tampan area became vegetated with thick forests and the Tampanian plain hunters and trappers in the surrounding areas may have migrated further a field.

It is suggested that the many herbivores represented by the numerous fossils remains in the three beds probably died due to a catastrophic flood event when they were trapped between the steep mogote limestone hills. The rushing floodwater is deemed to have swept down the plain borne by the Sungai Temelung from the north and northeast directions.

Tjia is of the opinion that the palaeo-Chenderoh Lake was already in existence before and after the 30,000 BP explosive event. He said that the ash found in the Kota Tampan palaeolithic tool workshop is mixed with the tool horizon and above it. His radiometric age of the algae on the limestone notch north of Lenggong indicate the extent of the Lake shore was 27,000 BP to 6,700 BP and is also an indication of the persistence of the lake until Middle Holocene.

It is suggested here that the cause of the landslide at Gunung Hong as postulated by Tjia (1993) could have been due to the intense rain that fell during that period. The intense rainfall that caused the massive landslides at Gunung Hong could be one of those which caused the catastrophic flood/s that trapped the herbivores. The skeletons and remains of the teeth that were accumulated outside the cave entrance were then swept inside the cave by the next flooding. The alluvial plain was denuded to below the cave entrance level and thus beyond the normal flood level. Calcification of the porous and sandy alluvial sediments with the bones and teeth then took place soon after.

The sediments with the fossils would have been very well protected if not for further entrance of water into the

cave. It is believed that reentrance of water may be related to the formation of the palaeo-Chenderoh Lake, which Tjia had deduced to have reached the 75 to 80 m level. (Note that the cave entrance is at about the 78 m level). The sediments in the Badak C cave must have been eroded by water that managed to enter through the cave entrance, leaving behind remnants of the fossiliferous beds.

PROPOSED CONSERVATION

The Late Pleistocene fossil bearing calcified alluvial sediments in Badak Cave C contain unprecedented numbers of fossil bones and teeth that are indicative of mass death. It is the first time such numbers of true vertebrate fossils has been located in one place in a limestone cave in Malaysia. The authors are of the opinion that the study of this site as a geological and vertebrate fossil locality is far from complete and would require the attention of many experts in various fields including geologist, paleontologist, zoologist, archeologist and geomorphologist. It is believed that when such study is completed it will certainly prove to be of significant value in terms of vertebrate paleontology, geology, archeology and other scientific fields.

At the same time, the authors are of the opinion that the fossils that are preserved in Badak Cave C are part and parcel of several interrelated events which have taken place in the past, of which we have very little record. If this inter-relation can be proven through the detailed study of the Badak Cave C, then the Tampanian community and the Perak Man will be given a stronger scientific back up. It is for this reason that we propose that the Badak Cave C be considered for conservation as a Geological Site of Special Scientific Interest (SSSI). Together the Gua Gunung Runtuh and the Kota Tampan palaeolithic tool workshop will form a geological-archeological complex of significance for Malaysia and is potentially an eco-tourist attraction.

CONCLUSIONS AND RECOMMENDATIONS

The remnants of three calcified alluvial beds in Badak Cave C, Lenggong, Ulu Perak contain the bones and teeth of mainly herbivores that are believed to have died catastrophically when trapped by flood. It must be regarded as a significant geological Site of Special Scientific Interest and as such must be conserved. It is believed to have happened prior to 30,000 BP when the Tampanian ancestors of the pre-ceramic epi-Palaeolithic Perak Man community were thriving in the Lenggong – Kota Tampan area. Detailed scientific study of this site involving experts from many scientific disciplines is recommended.

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