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Upper Pleistocene *Homo sapiens* from the Tabon cave (Palawan, The Philippines): description and dating of new discoveries

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Abstract

Among the poor fossil record of Southeast Asian Upper Pleistocene *Homo sapiens*, the Tabon human remains [12] are frequently cited in the literature despite very scarce published palaeoanthropological data. A recent Filipino-French joint work confirmed the significance of the discoveries made in the 1960s: a frontal bone and two mandibular fragments that have been recently described and dated [9]. Simultaneously, the archaeological potential of the Tabon site has been re-assessed and fieldwork organized by the National Museum of the Philippines yielded another eleven human remains. Palaeoanthropological description and new dating of the human fossils from Tabon cave are proposed and discussed. Some of the new dates obtained confirm the ca. 16 500 BP age of the frontal bone [9], but older ages have been obtained for other human fossils. The palaeoanthropological evidence suggests that all remains pertain to modern *Homo sapiens*. However, their high morphological variability is discussed in the frame of early *Homo sapiens* settlements in insular Southeast Asia. ***To cite this article: F. Detroit et al., C. R. Palevol 3 (2004)***.

Résumé

Les *Homo sapiens* du Pléistocène supérieur de la grotte de Tabon (Palawan, Philippines) : description et datation de nouvelles découvertes. Parmi les très rares *Homo sapiens* Pléistocène supérieur du Sud-Est asiatique, les restes humains de la grotte de Tabon [12] sont fréquemment cités dans la littérature, malgré l'absence de données paléoanthropologiques publiées. Une coopération franco-philippine a permis de confirmer la grande importance des découvertes effectuées dans les années 1960 : un os frontal et deux fragments mandibulaires ont été récemment décrits et datés pour la première fois [9]. Simultanément, le potentiel archéologique de la grotte de Tabon a été réévalué et les travaux de terrain organisés par le National Museum of the Philippines ont permis de mettre au jour onze nouveaux restes humains fossiles. La description paléoanthropologique et de nouvelles datations des fossiles humains de la grotte de Tabon sont proposées et discutées dans ce travail. Les dates obtenues confirment l'âge de 16 500 ans BP environ de l'os frontal [9], mais des âges plus anciens ont été obtenus pour d'autres fossiles.

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Ces restes humains présentent toutes les caractéristiques des *Homo sapiens* anatomiquement modernes ; leur large variabilité morphologique est discutée dans le cadre des premiers peuplements de l'Asie du Sud-Est insulaire par *Homo sapiens*. ***Pour citer cet article : F. Detroit et al., C. R. Palevol 3 (2004)***.

Keywords: Southeast Asia; Fossil *Homo sapiens*; Upper Pleistocene; Early settlements; Dating; U series

Mots clés : Asie du Sud-Est ; *Homo sapiens* fossile ; Pléistocène supérieur ; Premiers peuplements ; Datation ; Séries de l'uranium

1. The Tabon Cave: a key archaeological site in Southeast Asia

The Tabon Cave is located on the southwest coast of the Palawan Island (The Philippines: Fig. 1). The site has been thoroughly studied during the 1960s by Robert Fox from the National Museum of the Philippines [12].

Owing to the discovery of long-lasting human occupation layers, abundant lithic industries and human fossils, the Tabon Cave is frequently quoted as one of the most important Upper Pleistocene site from insular Southeast Asia [2,15]. Indeed, it is worth noting that the human fossil record of this large geographical area still suffers a major gap corresponding approximately to the Upper Pleistocene period. Thus, the Tabon human fossils are among the very scarce specimens that could candidate to stand chronologically between the latest Indonesian *Homo erectus* (such as Solo Man [16,19,22,28]) and the earliest *Homo sapiens* from insular Southeast Asia [3,6,17,21,23,25,26]. The age of the former group is still highly disputed, from more than 100 000 to less than 50 000 years BP [1,10,13,27], whereas the oldest anatomically modern *Homo sapiens* known up to now only date back to the very late Upper Pleistocene and Early Holocene period [6,16,26].

Despite their high significance, the human remains recovered from the Tabon Cave had not been described and published after their discovery. Nor there have been attempts to answer the numerous questions arising from the R. Fox's pioneering work until recent fieldwork was undertaken by the Archaeological Division of the National Museum of the Philippines [8].

A scientific collaboration between this institution and the Prehistory Department of the 'Muséum national d'Histoire naturelle' (Paris) resulted as a first step in the exhaustive palaeoanthropological description of these historical human fossil finds and direct dating of the Tabon frontal bone [9].

The purpose of the present article is to describe eleven new human fossils that have been recovered during the year 2000 field campaign. New direct datings, obtained from two human fossils unearthed from the Tabon Cave, are also discussed.

2. Human occupation layers and human fossils from the Tabon Cave

2.1. Archaeological context

Human occupation layers have been identified in the cave over a period dated between about 30 500 and 9000 years BP (series of 14C datings on charcoals: [12]). Lithic industries recovered from these layers

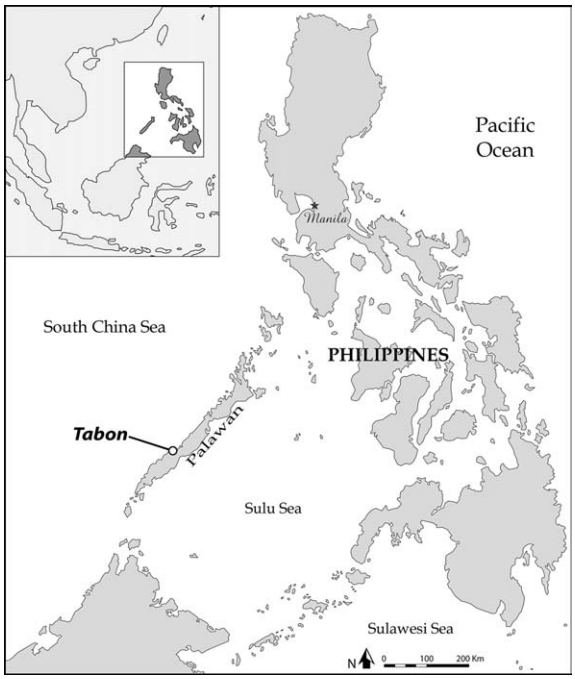

Fig. 1. Location of the Tabon Cave (Palawan, the Philippines).
Fig. 1. Localisation de la grotte de Tabon (Palawan, Philippines).

consist in abundant flake tools of various size and shape, mainly scrapers and sometimes denticulate scrapers. Fox proposed to name *Tabonian* this lithic assemblage, but some doubts have been raised regarding the specific characters of this assemblage, as compared to other insular Southeast Asian lithic industries from the same time period [11,20]. Faunal remains, including for instance *Cervus sp*. and *Sus sp*., are too scarce to depict precisely the faunal assemblage likely to be hunted by the Tabon cave dwellers during Upper Pleistocene times.

2.2. The fossil human remains

Beside jar burials recovered from the surface layers [2,12], more significant human fossils have been unearthed from the Upper Pleistocene layers of the Tabon Cave.

The uncertain status of the 'Tabon mandible' studied by Macintosh in 1978 [18] has already been pointed out [9] and will not be discussed here in further details. Paradoxically, it is the only previously published human fossil supposed to come from the Tabon Cave [18], though this mandible is quoted neither in the excavation reports nor in the published monograph [12]. Furthermore, the present depository of the original fossil is unknown, and only a cast is presently kept in the collections of the National Museum of the Philippines.

Thus, the historical and securely identified human fossils discoveries from the Tabon Cave consist of two mandibular fragments and one frontal bone [4,5,6,9,12]. They have been recovered in 1962, from an area located outside the main excavation zone and whose layers had been highly disturbed by 'Tabon birds' (Megapod birds). Based on the typology of the associated lithic tools, Fox correlated the age of the human fossils with the period corresponding to the Lithic Assemblage III identified in the reference stratigraphy (^{14}C ages ranging between 22 000 and 24 000 years BP). Such a chronological correlation has been frequently questioned [4,15], but almost 40 years after its discovery, the direct dating of the frontal bone to 16 500 ± 2000 years BP [9] unquestionably confirmed its Upper Pleistocene age. The relevant morphological and metrical characteristics of the fossils [9] are discussed in the light of the new discoveries in the conclusion of the present article. Indeed, the recent discovery of eleven human fossil remains provides an invaluable opportunity to improve dramatically our knowledge of the Upper Pleistocene *Homo sapiens* from insular Southeast Asia.

3. The recent discoveries

A series of new human remains has been recovered during the 2000 [7,8]. In a preliminary review of this new material, twelve fossils had been attributed to *Homo sapiens*. After an exhaustive study, we maintain the human determination for eleven specimens, excluding a small fragment of a long bone (No. IV-2000-T-329).

3.1. Cranial bones

3.1.1. No. IV–2000–T–188: right temporal bone

The fossil No. IV-2000-T-188 is a piece of right temporal bone, mainly consisting of the mastoid process (Fig. 2). The parieto-temporal suture is preserved along 18 mm, and the occipito-mastoid suture is visible on about 31 mm under the asterion. The anterior fracture of the fragment occurred just beside the external auditory meatus, which is not preserved.

The mastoid process is well developed, but not robust: it is wide in lateral view but not thick in anterior view (Fig. 2). Its external surface is irregular but shows neither strong tubercle nor delimited mastoid crest. The total height of the mastoid process is about 35 mm; the thickness of the marginal parts of the fragment varies from 5 to 7 mm along the occipito-mastoid suture up to 10 to 11 mm along the parieto-temporal suture.

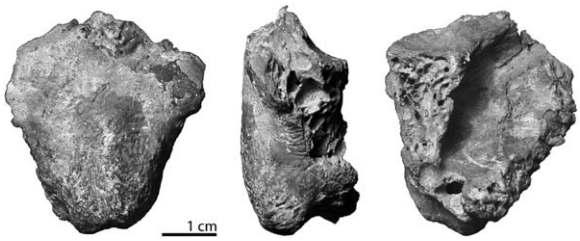

Fig. 2. Right temporal fragment (mastoid process, No. T-188) unearthed from the Tabon Cave in 2000 (lateral view, anterior view, internal view).
Fig. 2. Fragment de temporal droit (apophyse mastoïdienne, n° T-188) mis au jour en 2000 dans la grotte de Tabon (vue latérale, vue antérieure et vue interne).

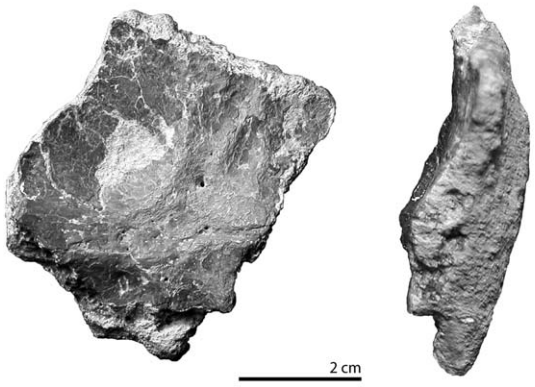

Fig. 3. Occipital fragment (No. T-372) unearthed from the Tabon Cave in 2000 (internal view and left lateral view).
Fig. 3. Fragment d'occipital (n° T-372) mis au jour en 2000 dans la grotte de Tabon (vue interne et vue latérale gauche).

3.1.2. No. IV–2000–T–372: occipital bone

The second cranial fragment (No. IV–2000–T–372) is a partial occipital bone (Fig. 3). Its external face is entirely covered by strong concretions that hide the outline of the nuchal lines. In lateral view a moderate thickening is visible, highlighted by a slight overlying depression that is probably located between the supreme and superior nuchal lines. As far as it can be observed, this structure seems to weaken transversally and does not constitute an actual occipital torus. There is no apparent external occipital protuberance.

The internal face is very well preserved and marked by several slight oblique crests. The right cerebral fossa is quite deep; it is visible on 25 mm along the transverse sulcus and 28 mm along the sagittal sulcus. The preserved right upper part of the cruciform eminence is thick.

3.2. Post-cranial bones (Fig. 4)

3.2.1. Upper limbs bones: No. IV-2000-T-276, right ulna proximal epiphysis

This proximal epiphysis of a right ulna (Fig. 4: lateral and anterior views) is preserved on 100 mm from the top of the olecranon, whose lower fracture occurs approximately at the level of the upper third of the diaphysis. Most of the surface of the bone is covered by concretions that we could only partly remove. The great sigmoid cavity is high (ca. 25 mm from the basis of the coronoid process to the basis of the olecranon) and the olecranon itself is narrow in anterior view (19 mm). Although largely covered by concretions, the ulnar tuberosities are clearly visible, forming two sub-vertical crests. The small sigmoid cavity is sub-vertical but poorly defined, and the tuberosity for the *M. brachialis* anterior is visible, but faintly marked.

In lateral view, the great sigmoid cavity is widely open.

On the medial side, the retro-sigmoid crest is slightly visible (hidden to some extent by sediment) but the retro-sigmoid tubercle, the *M. supinator* ridge, and the coronoid tubercle are well developed, though not acute.

The measured diameters confirm the small-to-medium overall dimensions of this ulnar fragment (sub-sigmoid antero-posterior diameter: 20.5 mm; sub-sigmoid transverse diameter: 18 mm; antero-posterior diameter at the level of the fracture: 12.5 mm).

3.2.2. Lower limbs bones

3.2.2.1. No. IV-2000-T-197: right tibia. This tibial lower diaphysis fragment is preserved on 130 mm length on its anterior face and 94 mm on its posterior face (Fig. 4: anterior view). None of the articular surfaces of the distal epiphysis is preserved. However, the uppermost part of the curvature of the medial border of the diaphysis is visible distally. As it usually gives rise to the medial malleolus, it allows attributing the fossil to a right tibia.

The respective distal prolongations of the anterior, soleal and interosseus crests are blunt and faintly visible on this fragment, though difficult cleaning prevents from an exact observation of these features.

3.2.2.2. No. IV-2000-T-170: diaphysis of left fibula. This 68-mm-long fossil fragment is a distal portion of a left fibula diaphysis (Fig. 4: anterior view). It is apparently located at the level where the interosseus crest (mainly located on the medial face) reaches the anterior face of the bone. However, its exact anatomical determination cannot be ascertained due to its small size. The maximal and minimal diameters of the fragment are respectively 15 mm and 9 mm.

3.2.2.3. No. IV-2000-T-365A: right fibula distal epiphysis. This right fibula distal epiphysis fragment is preserved on 75 mm in length and the maximal antero-

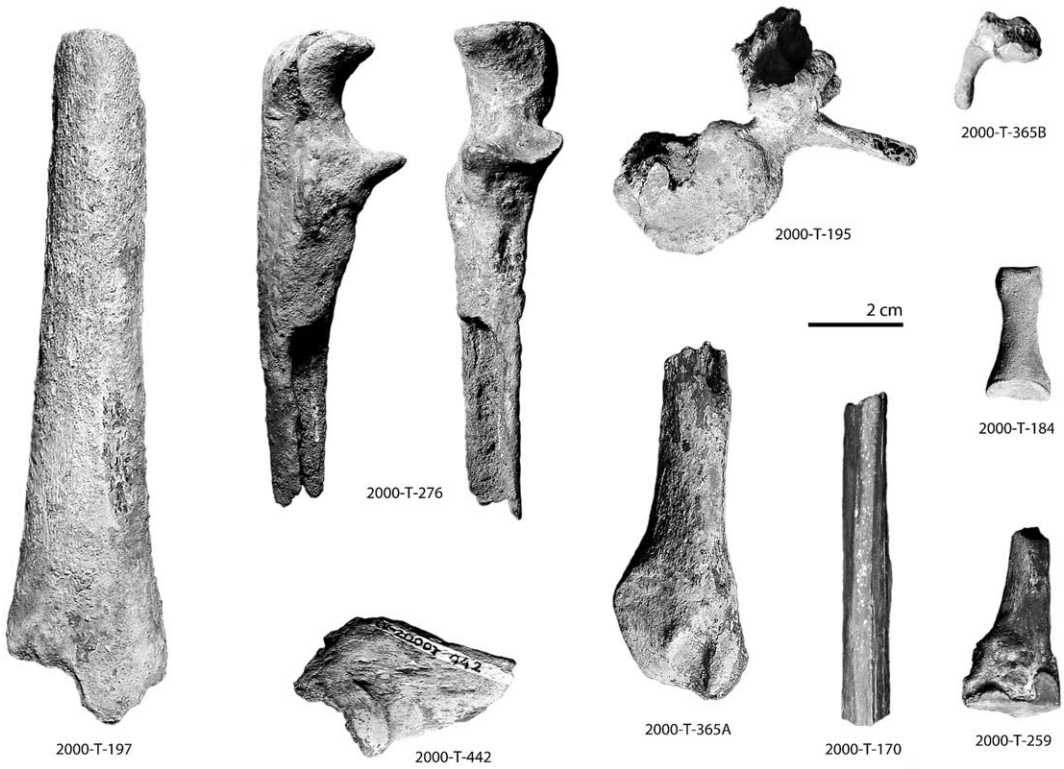

Fig. 4. Human post-cranial bones unearthed from the Tabon Cave in 2000 (see text and Table 2 for determination and exact provenience of each fossil).
Fig. 4. Os humains post-crâniens mis au jour en 2000 dans la grotte de Tabon (voir le texte et le Tableau 2 pour la détermination et la provenance exacte de chaque fossile).

posterior diameter of the preserved diaphysis part is 28 mm (Fig. 4: medial view). The proximal section of the diaphysis portion is flattened transversally; it is quite thick and marked by the blunt termination of the interosseus crest. The sub-vertical malleolar articular surface is ill defined, but the malleolar fossa is relatively deep and 'bean-shaped'.

3.2.2.4. No. IV-2000-T-442: right calcaneus. Only the infero-posterior part of this right calcaneus is preserved, on 45-mm length and 28-mm breadth. The postero-medial tubercle is well delimited by the acute border of the articular surface, while the quite elongated postero-lateral tubercle is not robust.

3.2.2.5. No. IV-2000-T-259: right third metatarsal. This proximal half of a right third metatarsal is preserved on a maximal length of 39 mm. The medial face of the proximal epiphysis shows two well-delimited facets for the second metatarsal, though the surface of the facet adjacent to the plantar border is very reduced (Fig. 4: medial view).

On the lateral face of the proximal epiphysis, the facet for the fourth metatarsal is oval-shaped and antero-posteriorly elongated. The plantar, medial and lateral surfaces of the proximal part of this metatarsal show well-developed tuberosities that are located in-between and distally to the articular facets.

3.2.2.6. No. IV-2000-T-184: fourth proximal left foot phalange. This fourth proximal foot phalange is complete and very well preserved (Fig. 4: dorsal view). The orientations of the head and of the proximal articular facet, together with the slight curvature of the shaft, allow us to side this phalange as a left foot phalange. Its total length is 28 mm. The proximal articular facet is slightly concave and well delimited. The shaft is rather broad and thick.

3.2.3. Axial skeleton

3.2.3.1. No. IV-2000-T-195: lumbar vertebra. This lumbar vertebra is incomplete and its whole surface is covered by concretions. The posterior portion of the vertebral body is damaged and incomplete on the right side. The right half of the vertebral arch and almost the whole spinous process are missing. The left half of the vertebral arch is relatively well preserved: it shows the inferior and superior articular facets and the transverse process. The transverse process is thin and strongly flattened antero-posteriorly.

The exact position of this isolated and partially damaged vertebra among the five lumbar vertebrae is difficult to determine accurately. The whole morphology points to a second or third lumbar vertebra, the overall dimensions supporting to some extent the latter determination (L3).

3.2.3.2. No. IV-2000-T-365B: immature atlas. The last post-cranial bone is the right half of an immature atlas (Fig. 4: inferior view). So far, the right and left sides of this atlas should not have been fused to form the bony rim that delimits the vertebral foramen, and the formation of the oval articulation for the odontoid process of the axis is not achieved. This developmental stage approximately corresponds to a one year-old anatomically modern *Homo sapiens*.

As a preliminary conclusion of this anatomical overview, we could notice that the newly discovered post-cranial fossil bones from the Tabon cave show similar overall morphological weakness and small to medium metrical proportions, with the obvious exception of the partial immature atlas (No. IV-2000-T-365B).

4. Direct dating of the fossils

New U-series direct absolute dating have been carried out on two human fossils recovered from the Tabon cave: the formerly discovered PXIII–T436 Sg19 mandibular fragment and the newly found IV-2000-T-197 tibia diaphysis. The results, ranging from 24 000 to 58 000 BP (Table 1), point to older ages than the one previously published for the frontal bone [9] and are consistent with Fox's assumption that human occupation in the Tabon cave dates back to the late Upper Pleistocene, starting more than 30 000 yr BP ago [12].

Although the association of human fossils of various ages is compatible with such a disturbed stratigraphical context, the oldest potential age of the human tibia (ca. 58 000 BP) has to be considered with caution. Its antiquity needs to be supported by the direct dating of more fossil specimens that are currently in progress. The next stages of the study will therefore be the dating of in situ speleothems, which are found within the archaeological filling, and new excavations in the main archaeological area in order to precise the stratigraphical correlations.

5. Discussion and conclusion: a promising site for tracing modern humans history in insular Southeast Asia

All the human fossils recovered from the Tabon cave (Table 2), including the early discoveries of the 1960s [9,12], show a similar aspect (reddish-brown colour of the bones and abundant concretions on the bone surface) that indicates that they probably underwent similar fossilization processes. Only a robust mandibular fragment from the earlier excavations (described in [9]) appears to be considerably more mineralized than the other fossils.

Due to its doubtful status, the mandible described by Macintosh [18] will not be included in our attempt to determine the minimal number of human individuals recovered from the Tabon cave. From the whole human fossil record, two specimens obviously differ from others. These are respectively the very robust mandibular fragment and the immature partial atlas. All other

Table 1
Direct dating (U-series) of three human fossils from the Tabon Cave.
Datation directe (séries de l'Uranium) de trois fossiles humains de la grotte de Tabon

Sample	U (ppm)	$^{234}U/^{238}U$	$^{230}Th/^{232}Th$	$^{230}Th/^{234}U$	Age (kyr BP)
Right mandibular fragment (PXIII–T436 Sg19)	0.56	1.169 ± 0.210	48	0.249 ± 0.049	31 + 8/–7
Tibia fragment (IV-2000-T-197)	1.11	1.174 ± 0.150	53	0.354 ± 0.061	47 + 11/–10
Frontal bone (P-XIII-T-288)[9]	2.88	1.115 ± 0.069	> 100	0.142 ± 0.016	16.5 ± 2.0

specimens (frontal bone, mandibular fragment No. PXIII–T436 Sg19, ulna epiphysis, tibia diaphysis, fragments of fibula, partial calcaneus, metatarsal, proximal phalange and lumbar vertebra) show medium-to-small proportions and morphological features that correspond to an overall weakly built anatomically modern *Homo sapiens*. Therefore, it seems possible that they belonged to a single individual and, from a strictly anatomical point of view, the minimal number of human individuals is 3 for the Tabon cave. However, the dating results, pointing to a discrepancy between the frontal bone, one of the fragmentary mandible and the tibia indicate a probable higher number of individuals.

Questions arising from these new discoveries deal with the relationships that could be traced between the specimens of the fossil record. From a biological point of view, one may ask whether the fossils unearthed represent one or more prehistoric human groups and, in a broader perspective, what are their phylogenetic relationship with other fossil *Homo sapiens* known from insular Southeast Asian sites such as Niah (Borneo [3,14,17]), Moh Khiew (peninsular Thailand [6,21]) and the Gunung Sewu area (East Java [6,23–25]).

Such a large comparative analysis needs to be treated exhaustively as one of the next step of this collaborative work. But some substantial data could already be highlighted from the anthropological descriptions and dating achieved as yet [6,9 and this work]. The association of specimens exhibiting respectively large and small overall dimensions points to the presence of at least two distinct *Homo sapiens* morphologies in the Tabon Cave during the Upper Pleistocene times. It could be the result of a taphonomic association of two actually distinct groups of *Homo sapiens* (biologically and/or chronologically) or only reflect the presence of a single group characterized by a high sexual dimorphism. However, the former hypothesis seems currently more likely. The unnumbered left mandibular fragment [9] shows an obviously more primitive overall morphology than any other individuals (large dimensions associated with a series of primitive morphological features). And, as a first impression, the pattern of association of morphological features documented by other specimens indicates to some extent affinities with Australian fossil *Homo sapiens*. For instance the conspicuous morphology of the supra-orbital complex of the frontal bone, which com-

Table 2
Exhaustive list of the human remains recovered from the Tabon Cave, datings (kyr = thousand years), and exact provenience of the fossils unearthed in 2000 (italicized No. IV-2000-T-329 is probably not human).
Liste exhaustive des restes humains mis au jour dans la grotte de Tabon, datations (kyr = millier d'années), et emplacements précis des fossiles exhumés en 2000 (le n° IV-2000-T-329 en italique n'est vraisemblablement pas humain)

Date of discovery	Inventory number	Anatomical determination	Datings (kyr BP) (U/Th)	Square	NS	EW	DP (datum plane)	*S* (surface)
2000	IV-2000-T-188	right temporal bone		S7W2	87	126	165	21
	IV-2000-T-372	fragment of occipital bone		S7W2	73	140	183,3	36
	IV-2000-T-365B	atlas fragment (juvenile)		S7W1	148	183	176	60
	IV-2000-T-195	3rd lumbar vertebra (or L2 ?)		S7W2	43	156	165,5	17
	IV-2000-T-276	right ulna proximal epiphysis		S7W1	191	163	116	16
	IV-2000-T-329	*non human – undetermined fragment*		*S7W1*	*154*	*173*	*136*	*35*
	IV-2000-T-197	diaphysis fragment of a right tibia	47 + 11/–10	S7W2	34	177	167	16
	IV-2000-T-365A	right fibula distal epiphysis		S7W1	148	183	176	60
	IV-2000-T-170	diaphysis fragment of a left fibula		S7W2	87	174	160	18
	IV-2000-T-442	right calcaneus fragment		S7W1	Quadrant B			
	IV-2000-T-259	right 3rd metatarsal		S7W1	158	147	108	12
	IV-2000-T-184	4th proximal left foot phalange		S7W2	40	89	158	3
1962	P-XIII-T-288	frontal bone (with nasal bones)	16.5 ± 2					
	P-XIII-T-436 Sg19	mandibular fragment (right side)	31 + 8/–7					
	No.? "robust mandibular fragment"	mandibular fragment (left side)						
?	? "Mandible" [18]	almost complete mandible						

bines projecting glabella and supraciliary arches with rather thin and clearly separated lateral trigones.

Those preliminary hypotheses call for future exhaustive analysis of the Tabon fossil remains within the Southeast Asian human fossil record. Further excavations and studies will hopefully address some major parts of those palaeoanthropological and chronological challenges, which presently make the Tabon cave one of the most promising sites for tracing modern human history in Southeast Asia since the Upper Pleistocene.

References

[1] G.J. Bartstra, S. Soegondho, A. van der Wijk, Ngandong man: age and artifacts, J. Hum. Evol. 17 (1988) 325–337.

[2] P. Bellwood, Prehistory of the Indo-Malaysian Archipelago, University of Hawaii Press, Honolulu, 1997 (revised edition), 384 p.

[3] D.R. Brothwell, Upper Pleistocene human skull from Niah Caves, Sarawak, Sarawak Mus. J. 9 (1960) 323–349.

[4] D. Bulbeck, Continuities in Southeast Asian evolution since the Late Pleistocene, unpublished M.A. thesis, Australian National University, Australia, Canberra, 1981, 575 p.

[5] F. Demeter, Histoire du peuplement humain de l'Asie extrême-orientale depuis le Pléistocène supérieur récent, thèse, université Paris-1, Panthéon–Sorbonne, France, Paris, 2000, 447 p.

[6] F. Détroit, Origine et évolution des *Homo sapiens* en Asie du Sud-Est : descriptions et analyses morphométriques de nouveaux fossiles, thèse, Muséum national d'histoire naturelle, Paris, France, 2002, 444 p.

[7] F. Détroit, E. Dizon, New discoveries and new studies of Upper Pleistocene *Homo sapiens* from the Tabon cave (Palawan, the Philippines) (Abstract) in : 17th Congress of the IPPA. Session 2: Settling the Islands, Human settlement of the Indo-Pacific and Australasian islands in the Pleistocene, Taipei, Taiwan, 2002.

[8] E. Dizon, W. Ronquillo Recent field campaigns on the Tabon site, Philippines (Abstract), in : Chronology of southeast Asian Palaeolithic since the late *Homo erectus* period Préactes du XIV^{e} Congrès de l'UISPP, Liège, Belgium, 2001.

[9] E. Dizon, F. Détroit, F. Sémah, C. Falguères, S. Hameau, W. Ronquillo, E. Cabanis, Notes on the morphology and age of the Tabon Cave fossil *Homo sapiens*, Curr. Anthropol. 43 (2002) 660–666.

[10] C. Falguères, Y. Yokoyama, T. Jacob, F. Sémah, Advancements in the dating of Solo Man, (Abstract), Chronology of southeast Asian Palaeolithic since the late *Homo erectus* period, Préactes du XIV^{e}, congrès de l'UISPP, Liège, Belgium, 2001.

[11] H. Forestier, Technologie et typologie de la pierre taillée de deux sites holocènes des Montagnes du Sud de Java (Indonésie), thèse, Muséum national d'histoire naturelle, Paris, France, 1998, 526 p.

[12] R. Fox, The Tabon Caves, Monograph of the National Museum, Manila, 1970, 197 p.

[13] R. Grün, A. Thorne, Dating the Ngandong humans, Science 276 (1997) 1575.

[14] T. Harrisson, The great cave of Niah, MAN 57 (1957) 161–166.

[15] W.W. Howells, The Pacific Islanders, Weidenfeld and Nicolson, London, 1973, 299 p.

[16] T. Jacob, Some Problems Pertaining to the Racial History of the Indonesian Region, Drukkerij Neerlandia, Utrecht, The Netherlands, 1967, 386 p.

[17] K.A.R. Kennedy, The Deep Skull of Niah: An assessment of twenty years of speculation concerning its evolutionary significance, Asian Perspectives 20 (1977) 32–50.

[18] N.W.G. Macintosh, The Tabon cave mandible (with appendix: Dental features of the Tabon mandible, by B.C.W. Barker), Archaeol. Phys. Anthropol. Oceania 13 (1978) 143–166.

[19] W.F.F. Oppenoorth, *Homo (Javanthropus) soloensis*. Een Plistoceene Mansch van Java, Wetenschappetyike Mededeelingen, Dienst Van Den Mijnbouw in Ned.-Indïe 20 (1932) 49–75.

[20] E. Patole, H. Forestier, Variability of Insulindian lithic industries of Late Pleistocene and Early Holocene, Chronology of southeast Asian Palaeolithic since the late *Homo erectus* period, Pré-actes du XIV^{e} congrès de l'UISPP, Liège, Belgium, 2001.

[21] S. Pookajorn, staff, Final report of excavations at Moh-Khiew Cave, Krabi Province; Sakai Cave, Trang Province and ethnoarchaeological research of hunter-gatherer group, socalled Mani or Sakai or Orang Asli at Trang Povince (The Hoabinhian Research Project in Thailand), Silpakorn University, Bangkok, 1994.

[22] A.P. Santa Luca, The Ngandong Fossil Hominids. A Comparative Study of a Far Eastern *Homo erectus* Group, Department of Anthropology, Yale University, New Heaven, 1980, 175 p.

[23] F. Sémah, A.-M. Sémah, T. Simanjuntak, More than a million years of human occupation in insular Southeast Asia: the early archaeology of eastern and central Java, J. Mercader (Ed.), Under the Canopy: The Archaeology of Tropical Rain Forests, Rutgers University Press, New Brunswick, NJ, USA, 2003, pp. 161–190.

[24] F. Sémah, A.-M. Sémah, C. Falguères, F. Détroit, X. Gallet, S. Hameau, A.-M. Moigne, T. Simanjuntak, The significance of the Punung karstic area (Eastern Java) for the chronology of the Javanese Palaeolithic, with special reference to the Song Terus cave, Modern Quat. Res. Southeast Asia (in press).

[25] T. Simanjuntak, Gunung Sewu in Prehistoric Times, Gadjah Mada University Press, Indonesia, Yogyakarta, 2002, 296 p.

[26] P. Storm, The evolutionary significance of the Wajak skulls, Scripta Geol. 110 (1995) 1–247.

[27] C.C. Swisher, W.J. Rink, S.C. Anton, H.P. Schwarcz, G.H. Curtis, A. Suprijo, Widiasmoro, Latest *Homo erectus* of Java: potential contemporaneity with *Homo sapiens* in Southeast Asia, Science 274 (1996) 1870–1874.

[28] F. Weidenreich, Morphology of Solo man, Anthropol. Pap. Am. Mus. Nat. Hist 43 (1951) 205–290.