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The perforated stones of the Doi Pha Kan burials (Northern Thailand): A Mesolithic singularity?

Les pierres perforées des sépultures de Doi Pha Kan (Nord de la Thaïlande) : une singularité mésolithique ?

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ABSTRACT

Throughout continental Southeast Asia, the Hoabinhian techno-complex stands out in clear contrast with the universal chrono-cultural model essentially established on the basis of western prehistory. Following this model, early authors considered perforated stones and associated lithic artefacts as markers of what was then believed to pertain to a Southeast Asian Mesolithic. However, Southeast Asian Mesolitithic has progressively been abandoned in favour of a ubiquitous Hoabinhian spanning from 30,000 to 3000 BP. Here, we present and discuss the discovery of perforated stones at the Doi Pha Kan site in northern Thailand. Perforated stones have almost never been found in undisturbed stratigraphic conditions nor dated with any sufficient degree of certainty. At Doi Pha Kan site, such a kind of artefacts was found in burials intersecting sedimentary layers that could be ascertained as Hoabinhian. In contrast with similar perforated stones described in the literature, that found at Doi Pha Kan are well-dated (13,000 BP), thus providing a time-reference for a putative Southeast Asian Mesolithic. We therefore advocate that such non-Hoabinhian artefacts support the early authors' hypothesis of the existence of a Southeast Asian Mesolithic. Finally, the funerary practices, the unusually high stature of individuals found at Doi Pha Kan in conjunction with the particular lithic assemblages further contributes to raise the question of the co-occurrence of several cultures or populations at the Pleistocene–Holocene interface in continental Southeast Asia.

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RÉSUMÉ

En Asie du Sud-Est continentale, le Hoabinhien se démarque clairement du modèle chronoculturel universel établi par la préhistoire occidentale. Sur la base de ce modèle universaliste, les premiers auteurs ont considéré les pierres perforées et les objets lithiques associés comme des marqueurs de ce qui se rapporterait à un Mésolithique du Sud-Est asiatique. Cependant, cette notion de Mésolithique régional a été abandonnée au profit d'un Hoabinhien ubiquiste présent de 30 000 à 3000 ans BP. Nous présentons et discutons la découverte de pierres perforées sur le site de Doi Pha Kan dans le Nord de la Thaïlande. Les pierres perforées n'ont presque jamais été mises au jour dans des contextes stratigraphiques intacts ni datés avec suffisamment de précision. À Doi Pha Kan, ce matériel lithique a été trouvé dans des sépultures intrusives de niveaux archéologiques hoabinhiens. Contrairement à celles, identiques, décrites dans la littérature, les pierres perforées mises au jour à Doi Pha Kan sont bien datées (13 000 BP), ce qui procurerait une base chronologique fiable pour représenter un possible « Mésolithique » du Sud-Est asiatique tel que le décrivent les auteurs pionniers travaillant dans cette région. En définitive, les pratiques funéraires, la stature inhabituelle des individus inhumés à Doi Pha Kan et leur association avec ce type d'assemblage lithique contribuent à soulever la question de l'existence conjointe de plusieurs cultures ou populations à la limite Pléistocène–Holocène en Asie du Sud-Est continentale.

1. Introduction

Bored stones, perforated stones, weight stones or donut stones are terms frequently coined to designate a range of round shaped stone artefacts with a central perforation. Globally, such artefacts do not appear to be a marker of any particular period. Classically associated with the European Mesolithic (Case, 1952), perforated stones are also known during the 2nd and 1st millennia BC in Taiwan or during Metal Age in Korea and Japan (Solheim, 1996) or historical periods (*id est* 900 to 1650 AD) in America (Koerper et al., 2009; Molitor, 2000; Moore, 1991) or even in New Guinea (Watson and Cole, 1977) and around 6000 BP in Papua (Gorecki and Gillieson, 1989). In Africa, some perforated stones were uncovered from older periods, such as at Matupi Cave in Democratic Republic of Congo, dated to 20,000 years BP (Van Noten, 1977) or at Border cave in South Africa, dated between 33,000 and 45,000 years BP (Beaumont et al., 1978). In India, while there are known examples of bored stones from the Upper Palaeolithic, such artefacts only became common during the Neolithic and Chalcolithic periods (Misra, 2001). In Southeast Asia, perforated stones were mainly uncovered out of any stratigraphic context and their chronology still remains unclear. In this paper, we first present a review of the regional archaeological literature, which allows us to reappraise the occurrence of this type of artefacts in Southeast Asia. Further, we present and discuss the perforated stones found in association with the burials of Doi Pha Kan in northern Thailand. In contrast with previous reports from Southeast Asia, this new find in a well-described stratigraphic context provided reliable dating of perforated stones and sheds new light on the early authors' hypothesis of the existence of a Southeast Asian Mesolithic distinct from the Hoabinhian.

2. Regional occurrences of perforated stones

In Southeast Asia, many archaeological sites have yielded perforated stones, but most of them were discovered out of stratigraphic context and/or without dating. Perforated stones were often uncovered in sites were burials are present, which raises the question of their exact dating due to the intrusive position of the burials in the deposits and due to the lack of detailed taphonomic description provided by authors in the past. It has been hypothesized that such perforated stones might have been used as clubheads, maceheads, weightstones for digging sticks, ring stones, net sinkers, bark beaters, spindle whorls, or even recently (cf. Tomasic, 2012) to make rope. Irrespective of their function, within continental Southeast Asia, they occur across a wide belt that mainly extends from northern Southeast Asia to southern China (Fig. 1).

Perforated stones have mainly been found (Table 1) and described in southern Chinese provinces. Such artefacts were described as weight stone in the Cave A at Wuming, near Paochiao, Guangxi province (Pei, 1935). A stratigraphy established by Teilhard et al. (1935) attributed this material to the very late Paleolithic to Mesolithic, without any further supporting evidence and even though most of the cultural deposits had been disturbed by modern local populations. In the same province, in the layer 6 of the eastern deposits of Bailiandong cave, according to Qu et al. (2013) "*a crude weight stone associated with hematite powder, choppers and crudely made ground tools*" was affiliated to a Mesolithic cultural stratum dating back to approximately 14,650 ± 230 BP. Other similar perforated stones dated between 7140 ± 60 BP and 9520 ± 90 BP have been found in the eastern layer 2 of Bailiandong cave as well as in the eastern layer 3, with a date of 11,180 ± 580 BP (Guoxing, 1994). At Dingsishan, a partly

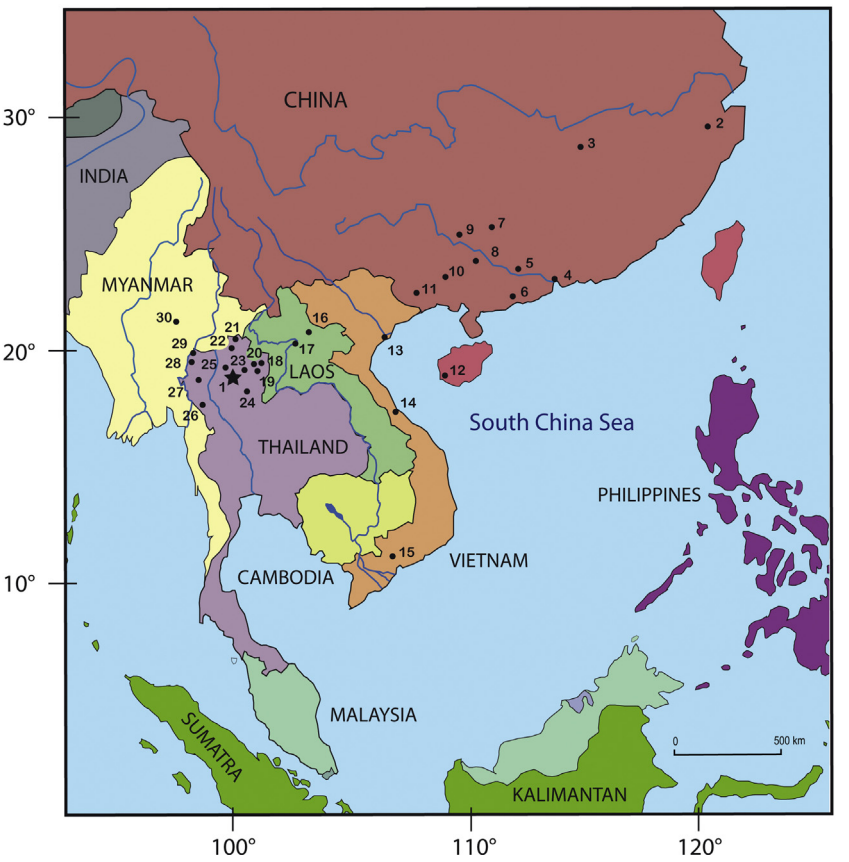

Fig. 1. Regional repartition of the sites including perforated stones in Southeast Asia: 1, Mae Moh, Ban Tha Si, Phratu Pha, Doi Pha Kan; 2, Shangshan, 3, Xianrendong, 4, Dongwangzi, 5, Liyuzui, 6, Dushizai, 7, Zengpiyan cave, 8, Xunjiang River sites, 9, Bailiandong, 10, Dingsishan, 11, Wuming, 12, Luobi cave, 13, Con Co Ngua, 14, Bau Du, 15, Hang Gon, 16, Tam Hang south, 17, Tam Nang Anh, 18, Tam Puulan, 19, Doi Phu Zhang, 20, Ban Dutai, 21, Tham Pra cave, 22, Pou Pan cave, 23, Tam Taew cave, 24, Ban Dann Chumpol, 25, Ban Tha Han, Ban Hang Hung, 26, Ban Nong Chalab, 27, Obluang, Ban Omkut, 28, Tham Pha Chan, 29, Bor Nam Pou Ron, Ban Non Haeng, Tam Lod, Ban Rai, 30, Padah-Lin.
Fig. 1. Répartition régionale des sites renfermant des pierres perforées en Asie du Sud-Est.

destroyed shell-midden site near Nanning city, perforated stones were uncovered in the cultural phases I and II with dating around 10,365 ± 113 BP for the middle of the second phase and around 6000 to 5500 BP in the fourth phase according to Xianguo (2002). Numerous sites in the Xunjiang River Valley, namely Niuweidong, Niugukeng, Shipeiling, Dawuoling, Gaoling, Talianling assigned to *circa* 9000–8000 BP include perforated stones (Rispoli, 2007). Perforated stones were also uncovered at Liyuzui for period I (*i.e.* 9000–8000 BP) and Zengpiyan cave for Phases IV–V (*i.e.* 8000–7500 BP) as well as Xiaojin for period 2 (*i.e.* 6000–5000 BP) (Rispoli, 2007). In Guangdong province, perforated stones were uncovered at Dongwangzi for the cultural period 3 (*i.e.* 6000–5000 BP) (Rispoli, 2007), but also at Dushizai cave in the cultural layers 2, 3 and 4 with radiocarbon dates of 12,845 ± 135 BP for the upper layer 2 (Zhao et al., 2004). In the Huangyandong cave, a fragment of perforated stoneware is associated with dated shells from 10,640 ± 300 to 11,580 ± 300 BP (Zhao et al., 2004). In Jiangxi province, according to Xingcan (1999), some perforated pebble disks, described as digging stick weights, and flat pebble adzes have been found in the early Neolithic (*circa* 9000–7500 BP) of Xianrendong Cave; however, these disks have been dated to around 15,090 ± 210 BP by Zhao et al. (2004). In Zhejiang province at Shangshan site, perforated stoneware were dated between 9610 ± 160 and 8050 ± 110 BP (Zhao et al., 2004). Recently, at Luobi cave in the South of Hainan Island, in the archaeological unit II dated between 10,642 ± 207 and 4520 ± 200 BP (Yinghua personal communication), four perforated tools made on cobbles of volcanic rocks were present.

In Myanmar, at Padah-Lin caves in Ywangan Township, Taunggyi district, Thaw (1971) describes the occurrence of many "*pebbles pitted in the center on both sides*" and numerous complete ringstones made out of sandstone and siltstone. The allocation of these objects to specific layers is not known, but the provided stratigraphic sequence indicates several archaeological layers dated from 1750 to 13,400 BP. In Laos, perforated stones were described by Fromaget and Saurin (1936) as "*steelyards obtained by drilling in the center of heavy discoid cobbles*". A first example of such pieces was uncovered from layers 0.2 to 1.1 m deep, in the lower Neolithic level at Tam Nang Anh. Fromaget and Saurin (1936) also found a similar artefact at Tam Hang south. In 1962, Saurin specified that these pieces were made of rolled andesitic cobble. Unfortunately, the

Table 1
Location and dating of perforated stones in southern Asia.
Tableau 1
Localisation et datation de pierres perforées dans le Sud de l'Asie.

Site	Archaeological references	Age	Dating method	Dated material	Chronological references
Shangshan	Zhao et al. (2004)	9610 ± 160 to 8050 ± 110 BP	Radiocarbon	Shell	Zhao et al. (2004)
Xianrendong cave	Xingcan (1999)	Early Neolithic 15,090 ± 210 BP	Radiocarbon	Shell	Xingcan (1999) Zhao et al. (2004)
Dongwangzi	Rispoli (2007)	6000 to 5000 BP	Cultural attribution	Ceramic	Rispoli (2007)
Cultural period 3					
Liyuzui	Rispoli (2007)	9000 to 8000 BP	Cultural attribution	Ceramic	Rispoli (2007)
Period I					
Zengpiyan cave	Rispoli (2007)	8000 to 7500 BP	Cultural attribution	Ceramic	Rispoli (2007)
Phases IV–V					
Xunjiang River Valley	Rispoli (2007)	9000 to 8000 BP	Culrural attribution	Ceramic	Rispoli (2007)
Bailiandong cave Layer 6	Qu et al. (2013)	14,650 ± 230 BP	Radiocarbon	Charcoal	Qu et al. (2013)
Layer 3	Guoxing (1994)	11,180 ± 580 BP	Radiocarbon	Charcoal	Guoxing (1994)
Layer 2	Guoxing (1994)	9520 ± 90 to 7140 ± 60 BP	Radiocarbon	Charcoal	Guoxing (1994)
Dingsishan	Xianguo (2002)	10,365 ± 113 BP	Radiocarbon	Charcoal	Xianguo (2002)
Cultural phase I and II	Xianguo (2002)	6500 to 6000 BP	Radiocarbon	Charcoal	Xianguo (2002)
Wuming cave A	Pei (1935)	Late Paleolithic to Mesolithic	stratigraphy		Teilhard et al. (1935)
Luobi cave	Yinghua	10,642 ± 207 to 4520 ± 200 BP	Radiocarbon	Shell	Ynghua
Unit II	Oral communication				Oral communication
Con Co Ngua	Nguyen Viet (2005)	6000 cal BP	Cultural attribution	Charcoal	Nguyen Viet (2005)
Upper layer					
Bau Du	Ha (1995)	5030 ± 60 to 4510 ± 50 BP	Radiocarbon	Charcoal	Ha (1995)
Hang Gon	Saurin (1962)	?			
Tam Nang Anh	Fromaget and Saurin (1936)	Early Neolithic	Cultural attribution		Fromaget and Saurin (1936)
Tam Hang south	Fromaget and Saurin (1936)	?			Fromaget and Saurin (1936)
Tam Puulan cave	Disayadej (1984)	?			
Doi Phu Zang	Prichanjit (2005)	?			
Ban Dutai	Disayadej (1984)	?			
Tham Pra cave	Prichanjit et al. (1996)	?			
Pou Pan cave	Imdirakphol (2012)	4500 BP	Radiocarbon	Charcoal	Imdirakphol (2012)
Tam Taew cave	Imdirakphol (2012)	Neolithic?			
Ban Dann Chumpol	Sorensen (1975)	?			
Ban Tha Han	Sorensen (1975)	?			
Ban Hang Hung	Sorensen (1975)	?			
Ban Nong Chalab	Sorensen (1975)	?			
Obluang	Santoni et al. (1990)	Hoabinhian	Cultural attribution	Lithic	Santoni et al. (1990)
Ban Omkut	Sorensen (1975)	Hoabinhian	Cultural attribution	Lithic	Sorensen (1975)
Tham Pha Chan cave	White and Gorman (2004)	7000 BP	Radiocarbon	Charcoal	White and Gorman (2004)
Bor Nam Pou Ron	White and Gorman (2004)	?			
Ban Non Haeng	White and Gorman (2004)	?			
Tam Lod	Shoocongdej et al. (2007)	?			
Ban Rai	Shoocongdej et al. (2007)	?			
Padah-Lin	Thaw (1971)	13,400 to 1750 BP	Radiocarbon	Charcoal	Thaw (1971)
Mae Moh	Imdirakphol (2012)	?			
Ban Tha Si	Zeitoun et al. (2013)	?			
Phratu Pha	Songsiri and Sangchan (2002)	?			
Doi Pha Kan dpk D4	This study	12,340 ± 50 BP	Radiocarbon	Bone	This study
dpk-E5		12,930 ± 50 to 11,170 ± 40 BP	Radiocarbon	Shell, bone Charcoal	

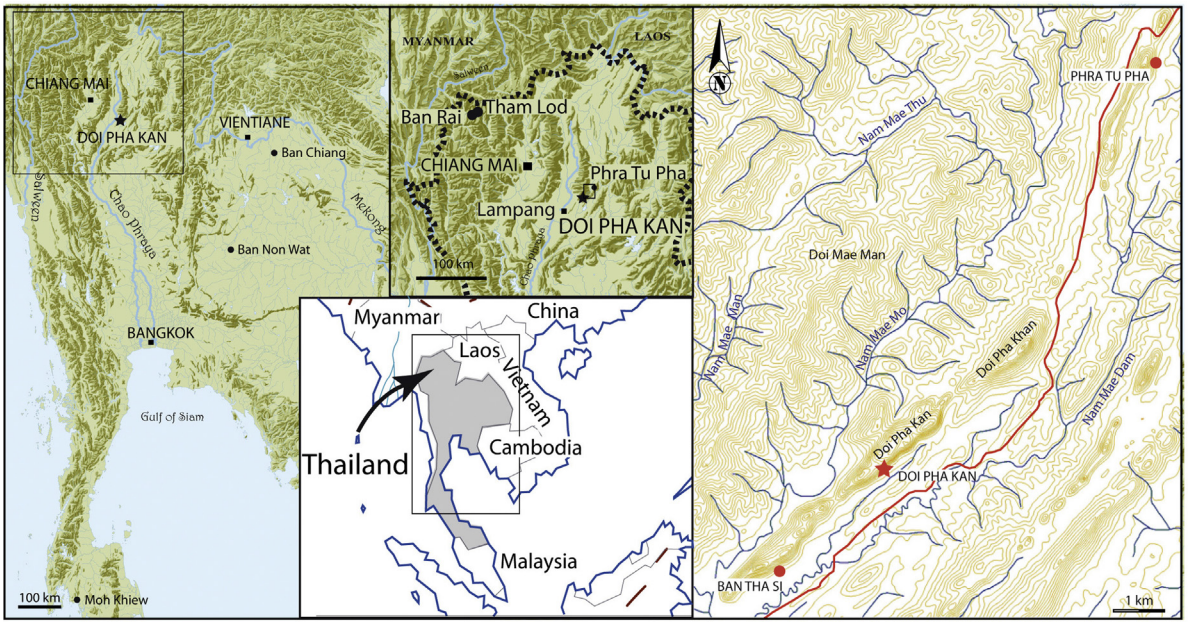

Fig. 2. Location of Doi Pha Kan site.
Fig. 2. Localisation du site de Doi Pha Kan

so-called lower Neolithic level of Tam Hang has not been dated. In Vietnam, Saurin (1962) collected a thick polished basalt cobble bearing a biconic hole and a smaller piece, which he considered to be a digging stone or mace, on the soil surface of the left river bank of Suoi Sau River close to Hang Gon. Also in Vietnam, Ha (1995) reported the presence of flexed burials at Bàu Du, Quàng Nam Dà Nàng, which were dug in deposits rich in Hoabinhian artefacts and which included an unfinished perforated stone. Radiocarbon dates obtained from charcoals found at this site yielded a chronological range from 4510 ± 50 to 5030 ± 60 BP, although it is not mentioned whether these dates relate to the burials or the deposits. Finally, Nguyen Viet (2005) indicated that weight stones were uncovered in the upper layer (*i.e.* circa 6000 cal BP) of the Da But culture of Con Co Ngua site in Hua Trung district, Tanh Hoa province.

In Thailand, in Lampang province, perforated stones were uncovered from the soil surface near the coalmine of Mae Moh (Imdirakphol, 2012) and at Ban Tha Han and Ban Hang Hung (Sorensen, 1975). At Tam Taew cave in the Klao Luang mountain, one perforated stone was associated with polished stone tools (Imdirakphol, 2012) and at Phratu Pha, four pieces were found on the soil surface (Songsiri and Sangchan, 2002). We also found two perforated stones out of context in the vicinity of the site of Ban Tha Si (Zeitoun et al., 2013). Other perforated stones have been found in the neighbouring northern provinces: in Phrae province, at Ban Dann Chumpol (Sorensen, 1975); in Nan province, at Ban Dutai and at Tam Puulan cave in both cases associated with undated stone tools (Disayadej, 1984); on the Doi Phu Zang mounts (Prichanjit, 2005) and in the basin of the Saaw River (Kijngam and Phumpongphat, 2006). One perforated stone described as a mace head was found in the Tham Pra cave in Chiang Rai province (Prichanjit et al., 1996). Numerous little perforated stones were discovered at Ban Na Tong in Pou Pan sepulchral cave, which has been dated back to 4500 BP (Imdirakphol, 2012). In Chiang Mai province, one perforated stone was picked up from the soil surface at Ban Omkut, together with other finds of Hoabinhan affinity and adzes (Sorensen, 1975); a perforated stone has also been collected at Obluang (Santoni et al., 1990). Still in the Thai northern provinces at Tham Pha Chan cave, one perforated stone was associated with material dated to 7000 BP (White and Gorman, 2004). Several perforated stones were uncovered from the ground surface at Ban Nong Chalab in Tak province and in Mae Hong Son province (Sorensen, 1975) and at Bor Nam Pou Ron, Ban Non Haeng rock-shelter (White and Gorman, 2004) but also at Tam Lod and Ban Rai (Shoocongdej et al., 2007).

3. Perforated stones of Doi Pha Kan

The archaeological site of Doi Pha Kan (N18°26.95 E 99°46.62′; Fig. 2) is located 7 km south of the rock art painting site of Phratu Pha (district of Ban Dong, Mae Moh, Province of Lampang) (Doy Asa et al., 2001; Songsiri and Sangchan, 1997) and 3 km north of the Ban Tha Si archaeological site (Zeitoun et al., 2013). The site is a rock-shelter that opens up in the eastern wall of the Doi Pha Kan mountain. Several red ochre painted figures of hands, carnivores, proboscideans, bovids and a gallinacae associated with anthropomorphic forms as well as geometric figures are present. Although many broken or incomplete perforated stones were uncovered in the archaeological deposits, two burials including perforated stones as offerings were discovered at the bottom of the Doi Pha Kan rock-shelter's painted wall, allowing reliable dating. Doi Pha Kan deposits are dusty loamy sediments accumulated over a depth of at

Fig. 3. Burial No. 1 (dpk-E5).
Fig. 3. Sépulture nº 1 (dpk-E5).

least two meters. Due to the loose nature of the deposits, it is not possible to undertake large excavations without disturbing sediments and the embedded archaeological remains. In term of geostratigraphy, no distinctive layer can be identified. The excavation of the site is still in progress, and currently 2144 Hoabinhian lithic artifacts and 31,716 faunal remains have been gathered, indicating a high mean density of the material, *i.e.* 3109 artifacts per cube meters. Due to the intrusive position of the burials and because of the refilling of the tomb by sediment, it is not yet possible to provide significant dating of the embedded lithic artifacts or of faunal remains.

The first grave (dpk-E5) (Fig. 3) was delineated by a circle of calcareous blocks 85 cm below the soil surface. The individual was lying in flexed position on its right side below these blocks. The orientation of the grave was NE–SW, with the individual's head in northward position. The skeleton was in poor condition and the upper part of the burial was not preserved. A layer of charcoal was covering the lower limbs, and the body was embedded in ochre. The grave comprised many offerings, including an adze, an axe with polished cutting edges, a large and a small pestle, a pendant made out of a bivalve shell as well as a frontal bone and a shaft of long bone of a common muntjac (*Muntiacus muntjak*) and a perforated stone (Fig. 4).

The second grave (dpk D4) (Fig. 5) was characterized by the presence of calcareous blocks partially covering the body of an adult individual. The main axis of orientation of the burial was SW–NE, the head of the individual being at the south. A large red ochre-tinged rounded stone was under the right side of the skull. The body was interred in a flexed position on the face. A perforated stone broken into two pieces was located on top of the blocks and a subtriangular-shaped perforated stone was present in the tomb in association with a red ochre coloured grindstone (Fig. 4). It should be noted that bioanthropological observations were undertaken directly on the field due to the bad preservation of the skeletons. The sexing was determined using the DSP method (Murail et al., 2005), while height was calculated from regional anthropological tables (Pureepatpong et al., 2012). Both individual are male with a probability over 98%. The height of the individual in the first burial (dpk-E5) has been estimated to be 174.9 ± 3.5 cm and the second (dpk D4) 172.5 ± 3.5 cm, indicating high statures.

4. Dating of the burials

Direct dating of these two burials and associated material was attempted. However, due to the lack of preserved collagen in the bone, only the structural carbonate present in the mineral fraction of the bone could be dated (bioapatite). Radiocarbon dating of bioapatite has proved useful in arid environments where post-mortem chemical exchanges between bone and the burial environment are limited (Zazzo and Saliège, 2011). As humidity is likely to promote carbon exchange, as dissolved bicarbonates, between the bone and the embedding soil, the humid tropics are not a suitable environment for dating carbonate in bioapatites. But this remains to be tested, and to our knowledge very little if any bioapatite-derived dates have been published so far in humid tropical contexts. In the first burial (dpk-E5), multiple dating was performed on charcoal, shell, bones and tooth apatite in an attempt to assess the relevance of dating derived from bone apatite. Samples were prepared at the Radiocarbon Laboratory of the MNHN following the protocols described in Zazzo (2014). Purified samples were either combusted or hydrolyzed and carbon dioxide (CO_2) was trapped in sealed glass tubes. Samples were sent to the Artemis AMS facility at Saclay for graphitization and radiocarbon measurement. Ages obtained ranged from $11{,}170 \pm 40$ to $12{,}930 \pm 50$ BP (Table 2). The consistency between the results obtained for charcoal and shell from the first grave (dpk-E5) is a strong indication that the inhumation including the offerings dates from the 14th millennium cal BC.

5. Discussion

5.1. A Hoabinhian context

Between the two World Wars, prehistoric researches in Southeast Asia resulted in the discovery of a large number of industrial *faciès*. Concurrently, many prehistoric "cultures" were defined, introducing a large degree of terminological confusion and uncertainty: the Anyathian, the Lannatian, the Nguomian, the Sonviian, etc. Most of these *faciès* were poorly characterized and lacked sound typo-technological definitions so that they finally fell into oblivion (Zeitoun et al., 2008). Only the Hoabinhian, which

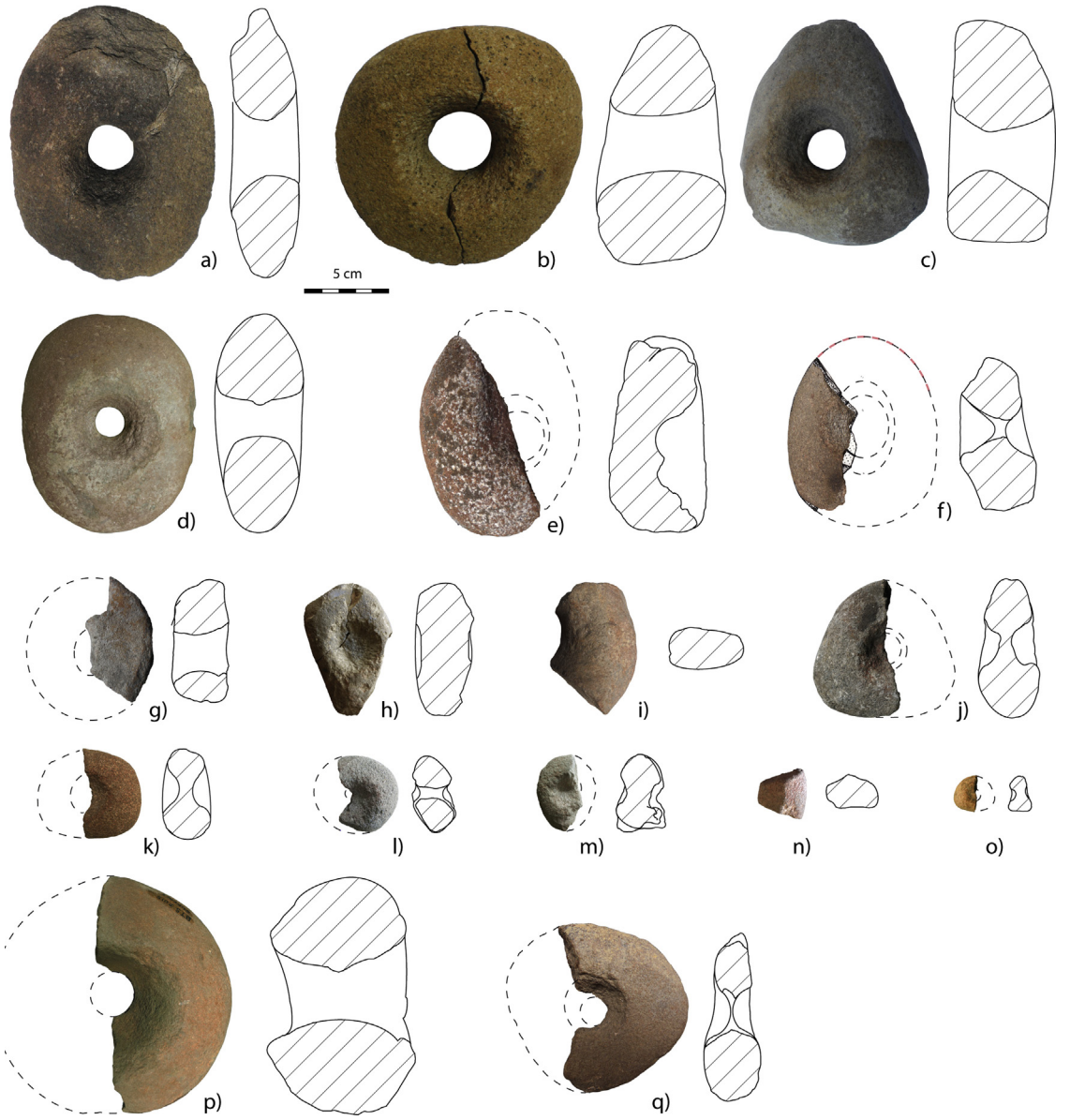

Fig. 4. a: perforated stone uncovered in the burial No. 1 at Doi Pha Kan; b and c: perforated stones uncovered in the burial No. 2 at Doi Pha Kan; d–o: perforated stones uncovered in the archaeological deposits at Doi Pha Kan; p and q: perforated stones uncovered at Ban Tha Si.
Fig. 4. a : Pierre perforée découverte dans la sépulture nº 1 à Doi Pha Kan ; b et c : pierres perforées découvertes dans la sépulture nº 2 à Doi Pha Kan ; d–o : pierres perforées découvertes dans les dépôts archéologiques de Doi Pha Kan ; p et q : pierres perforées trouvées à Ban Tha Si.

Table 2
Direct dating of the material excavated from the burials.
Tableau 2
Datation directe du matériel extrait des sépultures.

Site	Material support	Age BP $\pm 1\sigma$	Age BC (cal)	Lab references
Burial No. 1 (dpk-E5)	Human third molar	11,170 ± 40	11,263–10,929	SacA 27054
	Human femoral shaft	12,540 ± 50	13,169–12,462	SacA 27053
	Muntjac metapod diaphysis	12,210 ± 50	12,296–11, 895	SacA 27055
	Fresh water oyster shell	12,920 ± 80	14,242–13,077	SacA 27057
	Charcoal	12,930 ± 50	14,156–13,114	SacA 27056
Burial No. 2 (dpk-D4)	Human femoral shaft	12,340 ± 50	12,719–12,081	SacA 32916

Fig. 5. Burial No. 2 (dpk-D4).
Fig. 5. Sépulture nº 2 non recouverte (dpk-D4).

encompasses several tens of thousands of years (30,000 to 3000 years BP) is still considered today as it has been recognized at a number of well-known sites including caves and open-air sites. For nearly a century, the Hoabinhian has drawn the attention of researchers who have attempted to demonstrate the typological and geographic consistency of this original form of lithic assemblages on cobbles. Initially the Hoabinhian was considered as a transitional *faciès* between the Mesolithic and the Neolithic with an origin in the North Vietnamese Sonviian facies, defined from research on several sites and dated between roughly 25,000 and 10,000 years BP, in the province of Vinh Phù (Ha, 1980, 1997). Recent fieldwork carried out by Yi et al. (2008) in Hang Cho Cave provided finer chronometric resolution ranging between *circa* 19,500 and 8400 BP. The former oldest dating of 30,000–28,000 years BP obtained from the Tham Khuong site (Nguyen Van Binh, 1991) is now replaced by the Chinese site of Xiaodong in Yunnan near the Burmese boundaries with dates around 43,500 years BP (Ji et al., 2016).

In southern Thailand, the Lang Rongrien site presents an original assemblage of flakes and nuclei dated back to between 38,000 and 27,000 years BP, overlain by a "*classical Hoabinhian*" level with sumatraliths, and another level dated from around 6000 years BP and containing Neolithic pottery (Anderson, 1987, 1990). The rock-shelter of Moh Khiew also revealed a level dated from 26,000 years BP where flakes associated with polyhedric nuclei were found together with large Hoabinhian sumatraliths (Pookajorn, 1991; Pookajorn et al., 1994), which is of particular interest as it:

- raises the question of the variability of lithic technical systems within Hoabinhian lithic assemblages;
- allows a reconstitution of the relation between *debitage* and fashioning activities (Auetrakulvit et al., 2012).

In northern Thailand, numerous Hoabinhian caves and rock-shelter were uncovered in the region of Mae Hong Son (Forestier et al., 2005). Notably, the deposits of Ban Rai and Tham Lot were recently dated from around 9000 and 26,000 years BP, respectively (Shoocongdej, 2006). During this chronological range, several sites exist elsewhere in Thailand: Obluang (Santoni et al., 1990), Spirit Cave (Gorman, 1972), Tham Pha Chan (Bronson and White, 1992), Banyan Caves (Reynolds, 1992), Ong Bah (Sorensen, 1988), Khao Talu and Head Caves (Pookajorn, 1984), Pak Om and Buang Baeb (Srisuchat, 1987), Tham Kao Khi (Reynolds, 1989). More recent sites also exist near the Burmese boundary, such as Huai Hin dated from around 3700 BP (Forestier et al., 2013).

Even after almost a century of research and numerous attempts to improve the definition of the Hoabinhian, it is still restricted to a typological definition of knapped cobbles (Gouedo, 1987; Jeremie and Vacher, 1992; Matthews, 1964, 1966; Moser, 2001; Reynolds, 1989). Pookajorn's (1996) assessment of the Hoabinhian "techno-complex" was based on the artefacts of Moh Khiew, which are made from both cobbles and blocks, introducing some variability (cf. Auetrakulvit et al., 2012) but Gorman (1969, 1971, 1972) was the first to employ "technological criteria" in his analysis of Hoabinhian artefacts. Recent work (Forestier et al., 2005, 2013, 2015; Zeitoun et al., 2008) has suggested that it is more appropriate to consider the Hoabinhian as a functional techno-complex and three different components are recognized to define assemblages as pertaining to the Hoabinhian:

- the classic unifacial shaping on long cobbles to produce sumatraliths;
- the shaping of thick ovoid cobbles for the production of choppers or chopping-tools;
- the debitage to produce half-cobbles that are then shaped into tools.

5.2. Doi Pha Kan: a Mesolithic singularity?

Conspicuously embedded in a typically Hoabinhian context (stratigraphically and both chronologically and geographically), the burials of Doi Pha Kan, with their perforated stones, axe and adze with polished edges, pertain to the "classic Mesolithic style" described by early authors who first investigated the prehistory of the region (Colani, 1927; Fromaget and Saurin, 1936). The most remarkable features of Doi Pha Kan compared to previous similar sites are:

- the strict association of burials with perforated stones;

- the consistent dates obtained using different methods, which suggest a reliable age of 12,930 ± 50 BP for the oldest perforated stones.

Further, as skeletons found at Doi Pa Kan are of rather high stature, which is unusual within the rest of continental Southeast Asia, human remains and artefacts from Doi Pha Kan may correspond to a yet unknown population within the Hoabinhian world. Assuming, as proposed by early prehistorians, that perforated stones are indeed "fossiles directeurs", which means that they are, among others, markers of Mesolithic, the exceptional association of such artefacts with burials hints at the existence of a non-Hoabinhian, Mesolithic people in continental Southeast Asia.

However, the widespread lack of precise information in the literature dealing with Southeast Asian prehistory does not enable us to assert whether Doi Pha Kan is unique. For example, burials at Bàu Du (Ha, 1995) seem very similar to that of Doi Pha Kan as they include flexed skeletons intruding Hoabinhian archaeological levels together with perforated stones. However, in the absence of taphonomical description, the 4510 ± 50 to 5030 ± 60 BP radiocarbon dates available for the burials and deposits of Bàu Du in Vietnam cannot be used for the perforated stones. Likewise, at Padah-Lin caves in Myanmar (Thaw, 1971), unclear allocation of artefacts to 13,400 BP to 1750 BP archaeological layers renders it impossible to assess whether these values are of any relevance to date perforated stones. Currently, the oldest known perforated stones are that found in southern China at the Xianrendong Cave, dating back to about 15,090 ± 210 BP (Zhao et al., 2004) and that of Bailiandong cave (layer 6 of the eastern deposits), which were estimated to date back to about 14,650 ± 230 BP (Qu et al., 2013). Cultural layers 2, 3 and 4 of the Dushizai cave also delivered perforated stones dating from 12,845 ± 135 BP (upper layer 2; Zhao et al., 2004). However, precise dates for the Indian sites that delivered perforated stones are missing, and it remains impossible to formulate any migratory inference regarding the peoples who manufactured such artefacts, either from or towards China.

As regards to the spatial occurrence of perforated stones, they appear to be distributed within a well-delimited geographic area that encompasses Myanmar, Southern China and the Northern parts of Thailand, Laos, and Vietnam. They are not known or are very rare in the North or in the South of this relatively small region. Considering this spatial extent which is much more limited, particularly to the south, than that of the Hoabinhian, it is therefore possible that perforated stones are a marker of a non-Hoabinhian entity enclosed within a larger Hoabinhian space.

6. Conclusion

The regional overview presented in this paper indicates that the context of perforated stones discoveries remains overall unclear, with frequent associations with burials, thus implying some disturbance of the deposits at the time graves were dug. Perforated stones are therefore most often found in intrusive position within older or younger deposits, even though they are generally reported as being of the same age as the sediment in which they are embedded. At Doi Pha Kan, the strict association of burials with perforated stones and the consistent dates obtained with different methods suggest a reliable age of 12,930 ± 50 BP for the oldest perforated stones. Considering the Chinese chronology of perforated stones, on the one hand, and their spatial distribution in mountainous mainland Southeast Asia, on the other hand, we could define a chain of connection, through which ideas circulated along with other practices. To conclude, we should recognize that more research is needed to confirm or refute the existence of a putative Southeast Asian Mesolithic population and to clarify what characters distinguish it from the broader Hoabinhian culture.

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