Chapter

Prehistoric Human Migrations in Southeast Asia through the Lenses of Burial Practices

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Abstract

Burial practices commonly reflect cultural manifestations shared by a community. How deceased are interred can reflect belief systems, hygiene measures, or complex social diversification, among other factors. In modern times, these practices are highly standardized based on belief and social systems, with static rites repeated throughout time. In prehistoric times, it could be assumed that similar static systems would have been present, with the standing burial practices adopted by a community or including limited modifications. As such, similar mortuary practices in distant regions can provide evidence of migrations or cultural transmission. Extensive research carried out in Southeast Asia reveals diverse burial treatments during both synchronic and diachronic periods. Through a review of the burial practices identified in sites dated from the Late Pleistocene to the Holocene (until 3000ya) in Mainland and Island Southeast Asia, this chapter aims to address how mortuary practices can inform on prehistoric human migrations in Southeast Asia before the Austronesian dispersal. A specific case study is presented summarizing previous research in Tron Bon Lei (Alor Island, Indonesia).

Keywords: burial practices, archeothanatology, Southeast Asia, human migrations, Alor Island

1. Introduction

The study of prehistoric human migrations in Southeast Asia has been addressed from different points of view, including but not limited to the distribution of cultural material and biometrics [1–4], genetics [5–8], and modeling of migratory routes [9, 10]. Human internments, as a direct evidence of human presence on a site, can provide an alternative approach to address human migrations [11, 12]. Assuming that the rites associated to the internment of the dead would be shared by a given community and pass through generations, changes in the mortuary practices observed in funerary contexts or sites could reflect the arrival of new populations [12].

Human burials arguably represent the most planned and most ritualized archeological contexts, providing a key source of information about the past [13]. Although the analysis of funerary contexts has traditionally focused on the deceased, highlighting bioskeletal profiling and associated cultural material, the adoption of field

anthropology—or archeothanatology—for the study of burials have enhanced the way burials are recorded and interpreted. Initiated by French archeo-anthropologists in the 1960s and formalized in the 70s and 80s, *L'Anthropologie de terrain* or *archéothanatologie* (as originally coined in French), focuses not only on the human remains but also on the associated items (artefactual or not), their arrangement, and the entire funerary area, attempting to piece together the order of peri-mortem and post-mortem events to the time of excavation [11, 13–19].

Even though the adoption of archeothanatology in Southeast Asia has not been widely spread yet [11, 12, 20], several scholars have published detailed studies on burial practices including information about body positioning, skeletal articulation, palaeohealth, and grave associations, complementing more traditional bioanthropological data (i.e., sex, age-at-death, stature) [21–27].

As such, this chapter introduces the data available for burial practices in Mainland and Island Southeast Asia from the Late Pleistocene until the Austronesian dispersal. This review aims to evaluate if the adoption of different burial practices throughout this region follows a chronological order, which could be correlated with data from genetic and biometric sources, as well as evidence of maritime interactions as reflected in the dispersal of specific cultural material (i.e., shell beads, fishhooks, obsidian) [4, 6, 8, 28]. Additionally, this chapter presents a summary of the mortuary practices documented in Tron Bon Lei (Alor Island, Indonesia), as this site provides a remarkable example of changes in burial rites from the terminal Pleistocene to the middle Holocene [12, 29].

2. Burial practices in Southeast Asia from the late Pleistocene to the early Holocene

This review of burial practices has been divided according to body positioning. Three burial types have been selected: flexed burials, seated burials, and secondary burials. A flexed burial is defined as a burial position where the knees are drawn up the abdomen, with the arms extended or flexed [18]. Seated burials were originally described as based on the position of the trunk, distinguishing for being vertical or flexed anteriorly in seated burials instead of laying on one side in flexed burials [18]. However, decomposition can affect the position of the torso in a burial [30]. As such, seated burials are here described based on the position of the complete skeleton. Finally, secondary burials are those where elements are displaced or removed after some decomposition has occurred in a different location [11, 18]. Secondary burials differ from primary burials as the latter could be defined as deposits comprising the original place of corpse deposition, likely soon after death. As such, primary burials are likely to present articulated skeletal elements, preserved in anatomical position [15, 18]. Variability within primary burials includes body positioning (flexed, extended, arm positioning) and the timing of deposition in the funerary context (delayed with a period of corpse exposure against soon after death). Additional, post-mortem treatments such as cremation can hinder the original timing and post-mortem interval (PMI), as well as the body positioning.

The area of study comprises a large and diverse geographical zone, with the location of these internments being highly significant in relation to human migratory routes, as the transmission of mortuary practices would have implied different constraints related to topography and sea crossing requirements. As such, each subsection is separated into Mainland (MSA) and Island Southeast Asian (ISEA) examples, following a chronological order when appropriated.

2.1 Flexed burials in Southeast Asia

2.1.1 Island Southeast Asia

The recent publication of the Liang Tebo burial (TB1) pushed back the earliest evidence of flexed burials in SEA[1] by thousands of years (**Figure 1**). Dated to ~31 ka cal BP, and showing clear grave cuts, TB1 is a highly flexed burial, with the right knee at the chest and the left knee flexed below the pelvis, laying on the back [31]. Other flexed burials documented in Borneo date to the early to mid-Holocene, with the oldest burial being the B155 individual from Niah cave, directly dated to 8.4–9.1 cal BP. This flexed burial has been identified as an adult female, whose skull was intentionally removed after deposition [26]. Dated by association to the mid-Holocene, three flexed burials are reported from Kimanis (two individuals) and Gua Tenkgorak, although further details about the mortuary practices are lacking [32, 33]. Two flexed burials were also reported from Gua Keboboh, with chert cores, worked flakes, and a relatively high number of snail shells as associated cultural material as presumably dated to the Holocene [34, 35].

In Java (Indonesia), several burials dated to the Late Pleistocene and early/mid-Holocene have been documented, with sites like Goa Braholo, Song Terus, and Song Keplek on the south coast showing evidence of repeated human occupations [22, 36, 37]. In Goa Braholo, the oldest internments are the flexed burials BHL6 (14-17 ka cal BP) and BHL1 (10-12 ka cal BP). BHL6 consists of a highly flexed burial, with the knees flexed beside the body and flexed arms. BHL1, assigned to a young adult male, appears in a flexed supine position [22].

In Song Terus, an adult male was interred in a highly flexed position inside a "niche" on the cave wall, dated to 10.2–10.7 ka cal BP on associated marine shell [22, 23].

Another highly flexed burial was reported from Song Keplek, dated to 6.3–7.1 ka cal BP [38]. The young adult female was buried with extremely flexed legs, feet in hyper-extension and arms folded up along the body, a body positioning interpreted as resulting from wrapping or internment in a narrow burial pit.

In East Java, Song Gentong II yielded a fragmentary flexed burial with an uncertain Holocene date [22]**.** In West Java, the oldest flexed burial (PAW4) was documented in Gua Pawon directly dated to c. 10.2–11.2 ka cal BP, with a second highly flexed burial (PAW3), dated to c.7.7–8.4 [38].

Several burials dated to the mid-Holocene have been reported from Sulawesi (Indonesia). The site of Cappalombo 1 produced evidence of at least seven individuals, interred mainly in flexed position and dated by association to ~7.5 ka BP [39, 40]. In Leang Panninge, a flexed burial of a young adult female was dated to c.7.2–7.3 ka cal BP and remains the oldest example of successful aDNA extraction from a ISEA burial, providing invaluable data to evaluate prehistoric migrations in the region [7].

Finally, a middle Holocene flexed burial (~5–5.3 ka cal BP) was excavated in Bubog I (Illin Philippines). Containing a middle-aged adult individual, this burial did not produce evidence of bone modifications or grave associations, although there is evidence of intentional deposition of limestone slabs covering the burial [41].

[1] Borneo would have been part of the Sunda continental shelf during periods of low sea levels in the Late Pleistocene. Nevertheless, Borneo is included here as part of ISEA following current geographical distribution.

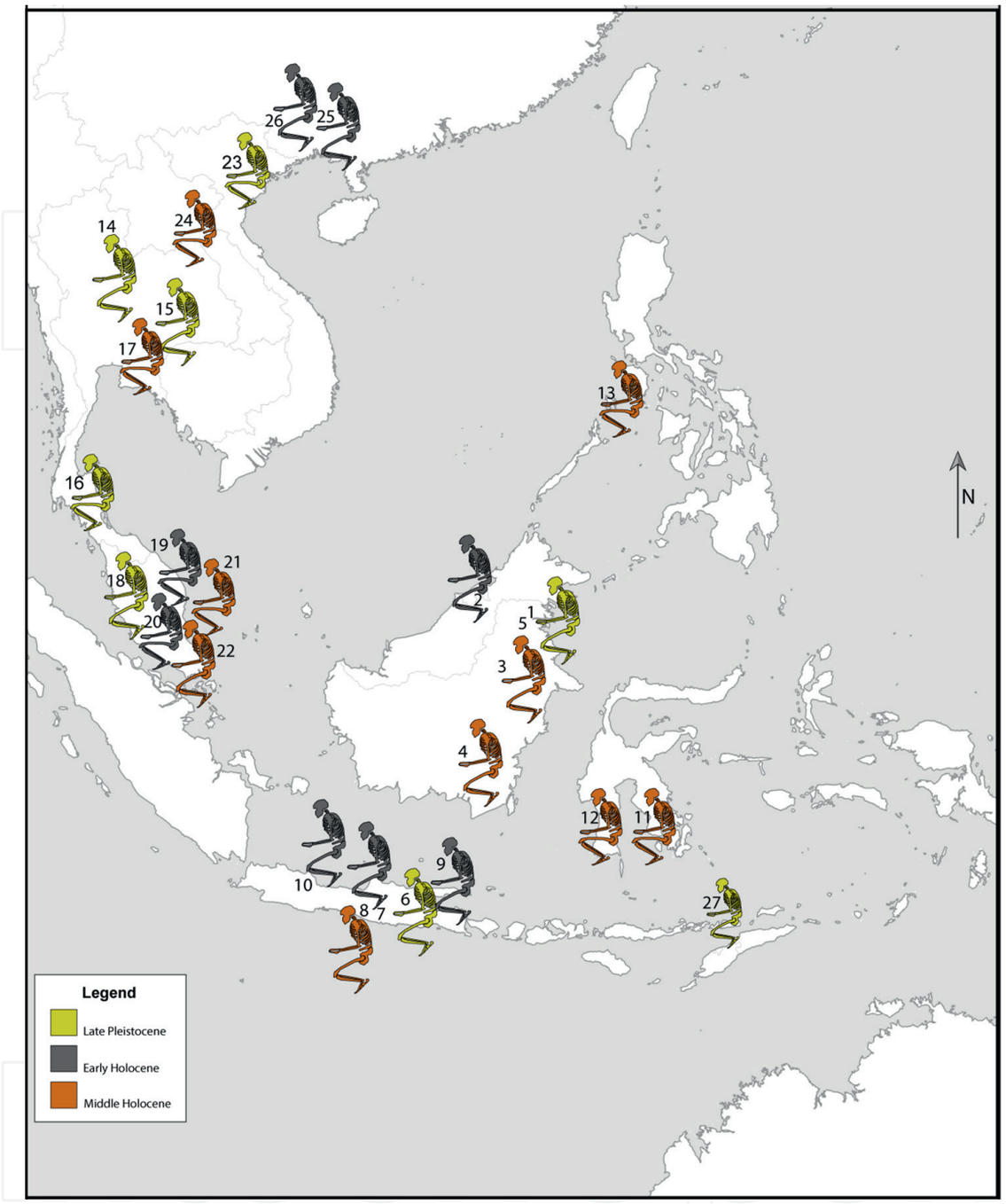

Figure 1.
Flexed burials documented in mainland and island Southeast Asia from the late Pleistocene to the middle-Holocene. Site numbers: 1—Liang Tebo; 2—Niah cave; 3—Kimanis; 4—Gua Tenkgorak; 5—Gua Keboboh; 6—Goa Braholo; 7—Song Terus; 8—Song Keplek; 9—Song Getong II; 10—Gua Pawon; 11—Cappalombo 1; 12—Leang Panninge; 13—Bubog I; 14—Tham Lod; 15—Ban rai; 16—Moh Khiew; 17—Ban Tha Shi; 18—Gua Kajang; 19—Gua Gunung Runtuh; 20—Gua Teluk Kelawar; 21—Gua Peraling; 22—Gua cha; 23—Han Cho; 24—Pha Phen; 25—Huiyaotian; 26—Dingsishan; 27—Tron bon lei. Site numbers do not indicate the precise location of the site. Figure modified from [12], originally published under CC BY 4.0.

2.1.2 Mainland Southeast Asia

The oldest flexed burials documented in MSEA were recovered in Thailand, ranging from the terminal Pleistocene to the mid-Holocene. The oldest burial from Tham Lod (c.16.2–16.7 ka cal BP) comprises an adult interred in flexed position

on one side, associated with large cobbles [42, 43]. In the Ban Rai site, a burial dated to 11–11.2 ka cal BP comprises a male individual interred in a supine flexed position [42].

In southern Thailand, an adult flexed burial (MKC91 B2) associated with manuports—large slabs and stone artifacts—was excavated at Moh Khiew dated by associated charcoal to 9.2–13.1 cal BP [22, 44]. Directly dated to c.8 ka cal BP, a burial from Ban Tha Shi (Thailand) comprises an adult male buried with the lower and upper limbs flexed, with the head absent [45].

The Malay Peninsula is another region with a large number of burials. The Gua Kajang site yielded a flexed burial (GK1) dated by associated shell to 11.9–12.6 ka cal BP (GK1) [46]. This burial consists of an incomplete skeleton of an adult male, presumably in a flexed position, based on the presence of articulated elements.

In Gua Gunung Runtuh, the "Perak man" comprises a highly flexed burial, with both legs folded up to the chest and laying on a supine position, dated by association to c.10.8–11.6 ka cal BP [24]. Also dating to the early Holocene (8.8–9.2 ka cal BP), the GTK1 individual in Gua Teluk Kelawar is an old adult female in a highly flexed fetal position, laying on the left side [24]. The best preserved of the burials documented in Gua Peraling (Gua Peraling 4) is dated to c.6-8 ka cal BP and have been interpreted as a primary flexed burial with significant post-burial disturbance, or an unusual secondary burial [47]. At Gua Cha, 15 flexed burials have been dated to c.6 ka cal BP [48].

Three other sites in MSEA yielded evidence of flexed internments during terminal Pleistocene-mid-Holocene. In northern Han Cho cave (Vietnam) is an old female buried in a supine flexed position directly dated to c.11kya cal BP [49]. In Laos, the Pha Phen site yielded a well-preserved flexed burial of an adult male, dated to c. 7.8 ka cal BP [21].

Finally, 16 of the burials identified in Huiyaotian (Guanxi province, China) and several of the internments in Dingsishan comprise flexed burial dated to the early/mid-Holocene (7-9 ka cal BP), although for the latter, no detailed bioskeletal profile analyses are available in English [50, 51].

2.2 Seated burials in Southeast Asia

2.2.1 Island Southeast Asia

The only recorded example of seated burial in ISEA comes from Niah cave (Borneo, Malaysia). Individual B147 consists of an adult female buried in a seated/squatting position, directly dated to c. 7.6-8 ka cal BP [26].

2.2.2 Mainland Southeast Asia

In the large burial site of Huiyaotian on the Guanxi region of China, 15 individuals were interred in a seated/squatting position, dated by association to the mid-Holocene (c.8.9-9 ka cal BP).

Presumably, the larger assemblage of seated burials in MSEA comes from Con Co Ngua in northern Vietnam, dated to c.6 ka cal BP. Dated to the same chronological period, a young individual was recorded in Tam Pong (Laos), described as seated/squatting while lying on the back [21, 52].

2.3 Secondary burials in Southeast Asia

2.3.1 Island Southeast Asia

The earliest evidence of a secondary burial in current ISEA was documented in Liang Lembudu (Aru Island)[2], dated by associated charcoal to 16-18 ka cal BP [53]. This secondary burial comprises an adult female secondary burial, with evidence of dismemberment and selective removal of elements. Based on the burial arrangement, researchers suggest that the skeletal elements were wrapped in some organic material and interred in bundles, with a large flat boulder partially covering the burial [53]. Also in Aru Island, a secondary burial was documented in Liang Nabulei Lisa, dated by association to the terminal Pleistocene (10-12 ka cal BP) comprising commingled remains from at least four individuals (**Figure 2**) [54].

In Goa Braholo (Java, Indonesia), BHL2 is the only secondary burial identified, dated to 9.8–10.2 ka cal BP from associated charcoal. This internment presumably shows selective removal of skeletal elements after the original deposition of the skeleton. Identified as a young female, this burial includes cranium, mandible, incomplete pelvis, and one cervical vertebra [22, 23].

From the several burials identified in Ille cave (northern Palawan, Philippines), B758 (c.9–9.6 ka cal BP) has been identified as a partial skeleton of a young-mid adult female [55, 56]. The skeletal elements display post-mortem modifications related to dismembering and defleshing, with remains wrapped in an organic container and buried at the cave entrance.

A large number of burials have been recovered from Niah cave (Borneo, Malaysia), dated from the early to the late Holocene, including several Neolithic internments that are not covered in this review (see [27] for a review of Neolithic burials in the site). Burial B92, dated to c.7.3–7.6 ka cal BP, comprises a secondary burial of a child, whose skull has been removed [26, 55, 57, 58].

Another child burial was excavated at Gua Makpan, directly dated to the mid-Holocene (~8 ka cal BP) [11]. In this case, the long bones were intentionally removed, although the unfused epiphyses were preserved in the internment. This fact, as well as the articulation of fragile skeletal elements (i.e., phalangeal epiphyses) and the absence of cutmarks, suggests the use of some kind of wrapping material or a delayed primary burial, with the skeleton being exposed prior to internment and buried before complete decomposition of the soft tissue [11].

In Liang Jon (Borneo, Indonesia), two secondary burials were recorded. Burial ST3, dated to 6.3–6.5 ka cal BP, comprises a deposit of disarticulated cranium, mandibles, scapulae, tibia, and vertebrae. Evidence of post-mortem manipulation of the remains includes evidence of intentional breakage, ochre coating, and cutmarks [34]. Another secondary burial from Liang Jon was dated by association to ~7.5 ka cal BP with a direct date of 4 ka cal BP, placing the burial in the mid-late Holocene [59]. Although the description of skeletal elements and body positioning is ongoing, preliminary studies indicate that only the cranial and appendicular elements (i.e., hand and foot bones) were documented in the burial (Maloney and Dilkes-Hall, pers. comm.). The selected elements were differentially treated, as demonstrated by the intentional application of pigment to the cranial vault, as well as the presence of shell grave goods [59].

[2] Although Aru Island was part of the Sahul continental shelf during the terminal Pleistocene, this review includes burials documented in Aru Island as Liang Lembudu is still the oldest example of secondary burial precisely described from current Island Southeast Asia.

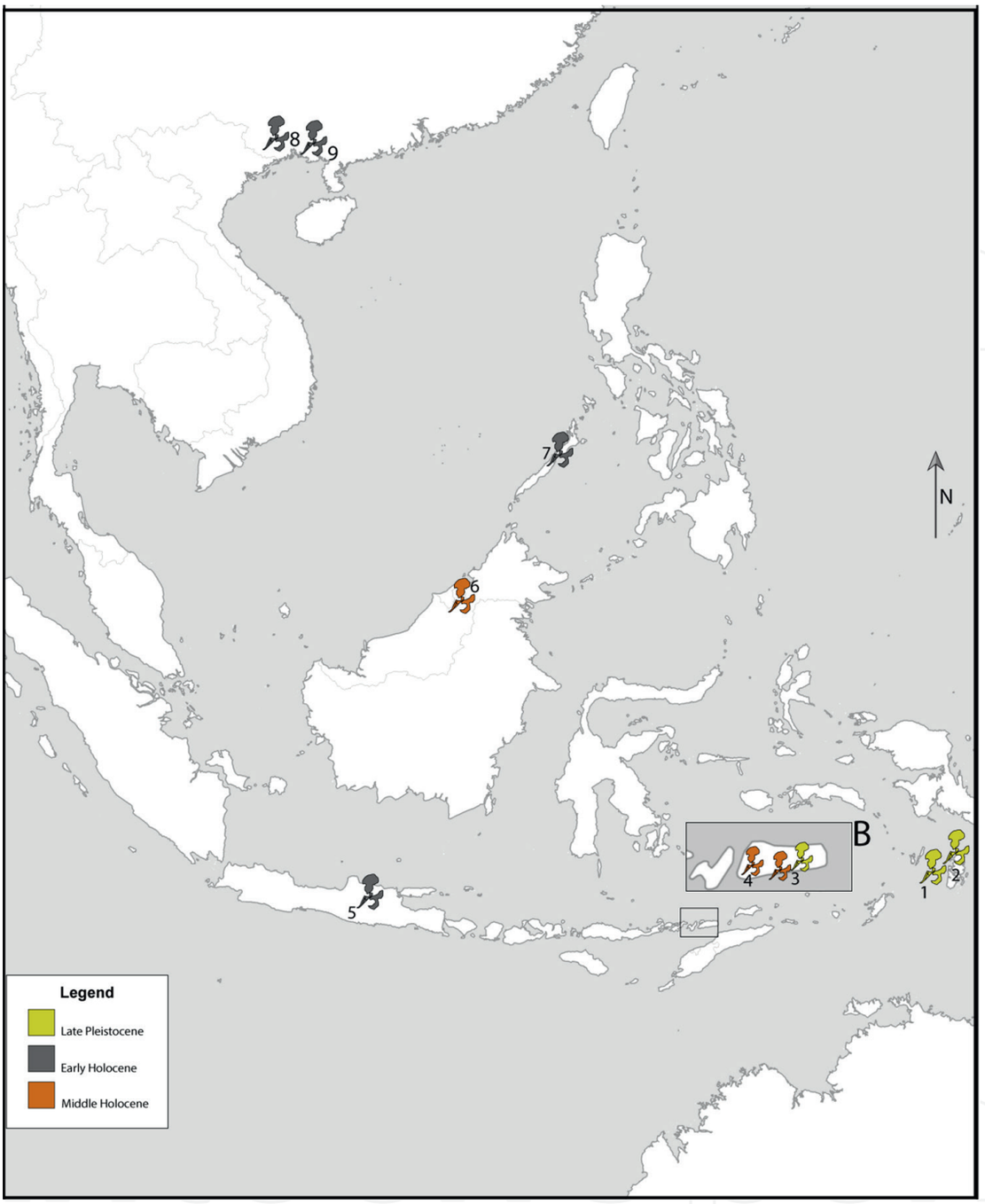

Figure 2.
Secondary burials documented in mainland and island Southeast Asia from the late Pleistocene to the middle Holocene. Site numbers: 1—Liang Lembudu; 2—Nabulei Lisa; 3—Tron bon lei; 4—Gua Makpan; 5—Gua Braholo; 6—Niah cave; 7—Ille cave; 8—Dingsishan; 9—Huiyaotian. Site numbers do not indicate the precise location of the site. Rectangle indicates the position of Alor (inset B). Figure modified from [12], originally published under CC BY 4.0.

2.3.2 Mainland Southeast Asia

The only evidence of secondary burials from Mainland Southeast Asia dated to the early to mid-Holocene comes from the burial sites of Huiyaotian and Dingsishan (Guanxi province, China). From the more than 30 burials recorded in Huiyaotian dated to the early Holocene (~9 ka cal BP), three were identified as secondary burials, although detailed description of the body position is yet unavailable [50]. No detailed

data on mortuary practices other than a general description of burial type (secondary or flexed) are available for Dingsishan [51, 60].

3. Tron Bon Lei: an example of an archeothanatological study of prehistoric burials in Alor Island, Indonesia

3.1 Site background

Tron Bon Lei consists of two adjoining shelters located in a volcanic ridge on the south coast of Alor, near Lerabain village (**Figure 3**). It is located 35 m asl and 160 m inland [61].

In 2014, an Australian-Indonesian team excavated three test pits (A, B, and C), with square B providing the largest and best-preserved deposit. A total of twenty chronostratigraphic radiocarbon dates from square B identified four periods of human occupations: Late Pleistocene (18-21 ka cal BP; Phase I), terminal Pleistocene-early Holocene (9-13 ka cal BP; Phase II), middle Holocene (7-8 ka cal BP Phase III), and late Holocene (2-5 ka cal BP Phase IV) [12].

Square B yielded a large amount of vertebrate and invertebrate remains, with the vertebrate fauna dominated by fish [61, 62] and the invertebrate fauna to be published. The fish assemblage from Tron Bon Lei indicates a more intense occupation after the Last Glacial Maximum (LGM), with a larger number of vertebrate bones from the terminal Pleistocene to the middle Holocene (Phases II and III) [62]. Fish families identified indicate reliance on reef fish, with presence of pelagic specimens only on the Pleistocene layers (Phases III and IV).

The analysis of fish bone representation shows changes in the carnivore/herbivore fish ratio and fish size from the Pleistocene to the Holocene, with a larger percentage of carnivores and larger size fish during the Pleistocene [62]. Nevertheless, the isotopic signature of the human remains suggests a mixed/terrestrial diet, with presumably a larger contribution of marine protein in Pleistocene individuals [63].

The quantity of obsidian and basalt artifacts also peaks during Phases II and III [64]. Knapping systems indicate a specialized bipolar reduction of obsidian cores, while basalt cores were expediently knapped producing larger flakes [64]. Three obsidian sources have been identified in Tron Bon Lei, with one of the sources been also identified in sites on Timor-Leste, providing evidence of maritime interaction from the terminal Pleistocene [28].

3.2 Human burials documented in Tron Bon Lei

At the end of the 2014 excavations in Tron Bon Lei, several human remains appeared in squares B and C, which were excavated in blocks and further analyzed at the Australian National University. The skeletal elements from square C appear disarticulated, located in three distinct accumulations on the same horizontal plane [29]. Large cobble, comprising manuports, were recorded around the bone accumulations. Anatomical representation comprises crania, mandibles, and scarce postcranial remains from a minimum of two adult individuals [29]. One of the individuals (TLC-1) was directly dated to ~17 ka BP through U/Th dating.

In square B, a mostly complete skull, with fishhooks placed on the neck, appeared on the southeast corner of the 1x1m pit. With time limitations to be able to excavate the remaining skeleton extending toward the wall of the pit, the cranial remains

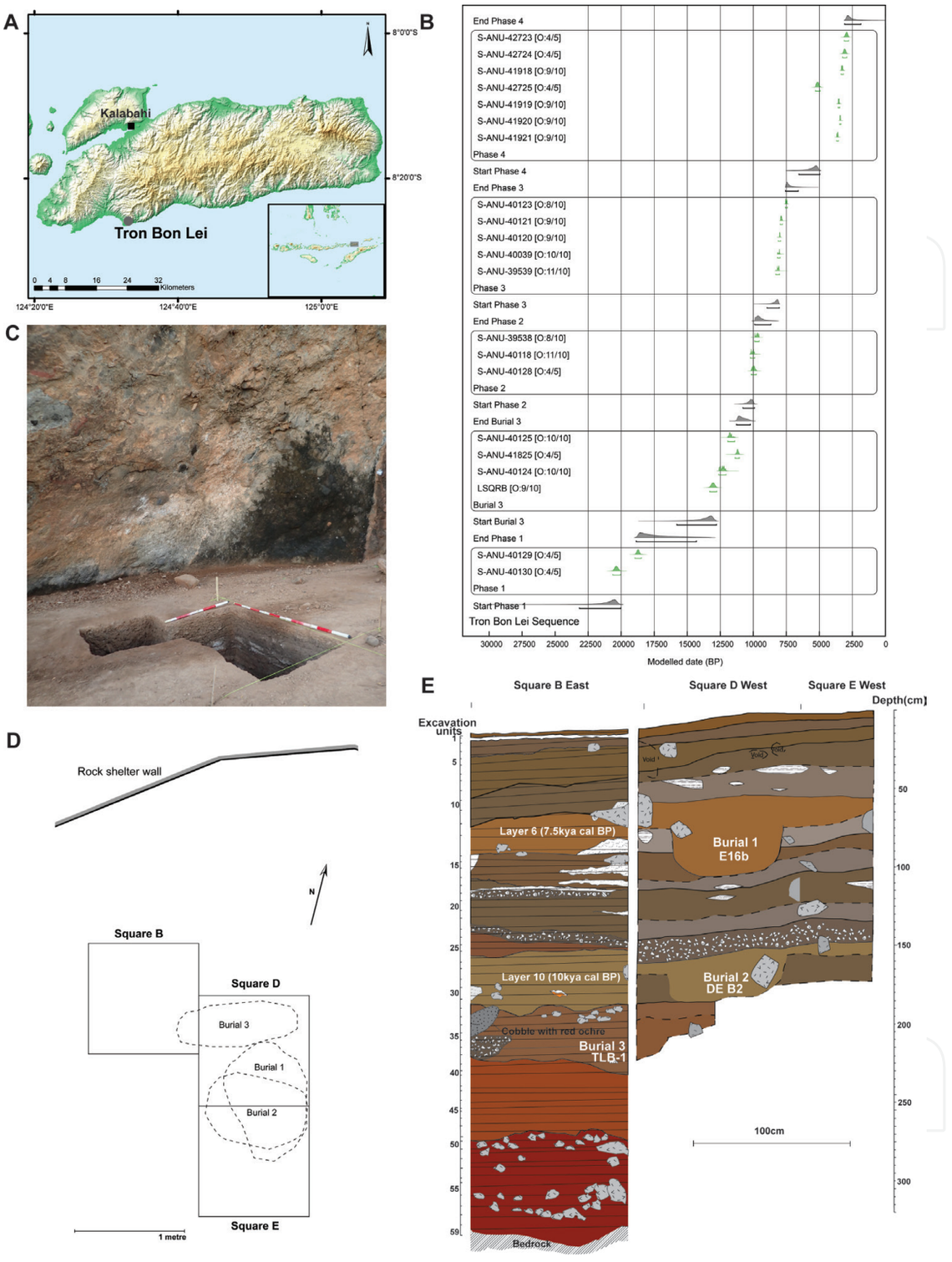

Figure 3.
(A) Location of Tron bon lei on the south coast of Alor. (B) Bayesian model of dates from square B in Tron bon lei. For full details on the model, refer to [12]. (C) General view of square B (left), D (top right), and E (bottom right); (D) schematic drawing illustrating the position of the grave cuts; (E) combined stratigraphy for squares B, D and E. Figure modified from [12], originally published under CC BY 4.0.

were excavated and transported to the laboratory. Radiocarbon dates from the fish-hooks and piece-plotted charcoal samples, as well as a direct date on U/Th, place this burial ~13 ka cal BP [29].

Craniometric data from these individuals identify them as a distinctive morphological group from the Pleistocene individuals from Sunda and Sahul, supporting the presence of a gracile group living in ISEA since at least the Pleistocene and surviving into the Holocene [29].

In 2018, a second archeological season was undertaken in Tron Bon Lei, aimed at completing the recovery of the human remains from square B. Square D extended the test pit toward the southeast, until ~80 cm depth when a cobble accumulation preceded the identification of a grave cut. This prompted the excavation of another $1m^2$ to the south (square E) to recover this burial (burial E16b). A further burial appeared at around 1.6 m depth, located between squares D and E and equally preceded by another cobble accumulation (**Figure 3c**). Correlation with the chronometric date obtained from square B date these burials to 7.5 ka cal BP (E16b) and 10 ka cal BP (DE B2) [12]. Finally, at ca.2.3 m depth, the original burial was located (TLB-1).

This manuscript provides a review of the burials identified in Tron Bon Lei following a chronological order.

3.2.1 Square C burials (TLC-1, TLC-2, TLC-3)

The most complete remains identified in square C appear in TLC-1, where a complete mandible, maxilla, and fragmented cranium were documented in association with some vertebrae, ribs, carpal, and foot phalanges [29]. Bioskeletal profiling suggests a male individual with an age-at-death of ca.50 years old. Unfortunately, the incomplete data associated with element position for the square C human remains hamper the study of mortuary practices, loosely classifying the TLC-1 burial as a secondary burial.

3.2.2 TLB-1 individual: a terminal pleistocene flexed burial

The oldest burial documented in square B comprises a primary flexed burial. The upper limbs appear extended across the body, with hands flexed inward and laying on the left side (**Figure 4a**). The skeleton is completely articulated, indicating the absence of post-burial disturbances and presumably a rapid internment before decomposition onset.

Age and biological sex estimations based on cranial and postcranial traits identified the TLB-1 individual as a likely female of a minimum of 45 years old at death. Stature estimations yielded a height of ca.152 ± 6 cm, placing the individual within the stature range reported form ISEA Holocene and modern females [65, 66].

The TLB-1 individual presents several lesions with severe dental pathologies, including antemortem tooth loss and a large caries on the left lower third moral, which formed a periapical cyst [12].

The burial is associated with manuports, cobbles covered on red ochre positioned above and beside the burial. One of the most remarkable characteristics of the TLB-1 burial is the presence of five shell fishhooks made on *Tectus niloticus* shell and a perforated bivalve found around the neck [67]. These unique grave goods constitute the earliest fishhooks in a burial context to date, supporting the role played by fishing and exploitation of marine resources by the inhabitant of Tron Bon Lei during the terminal Pleistocene [67].

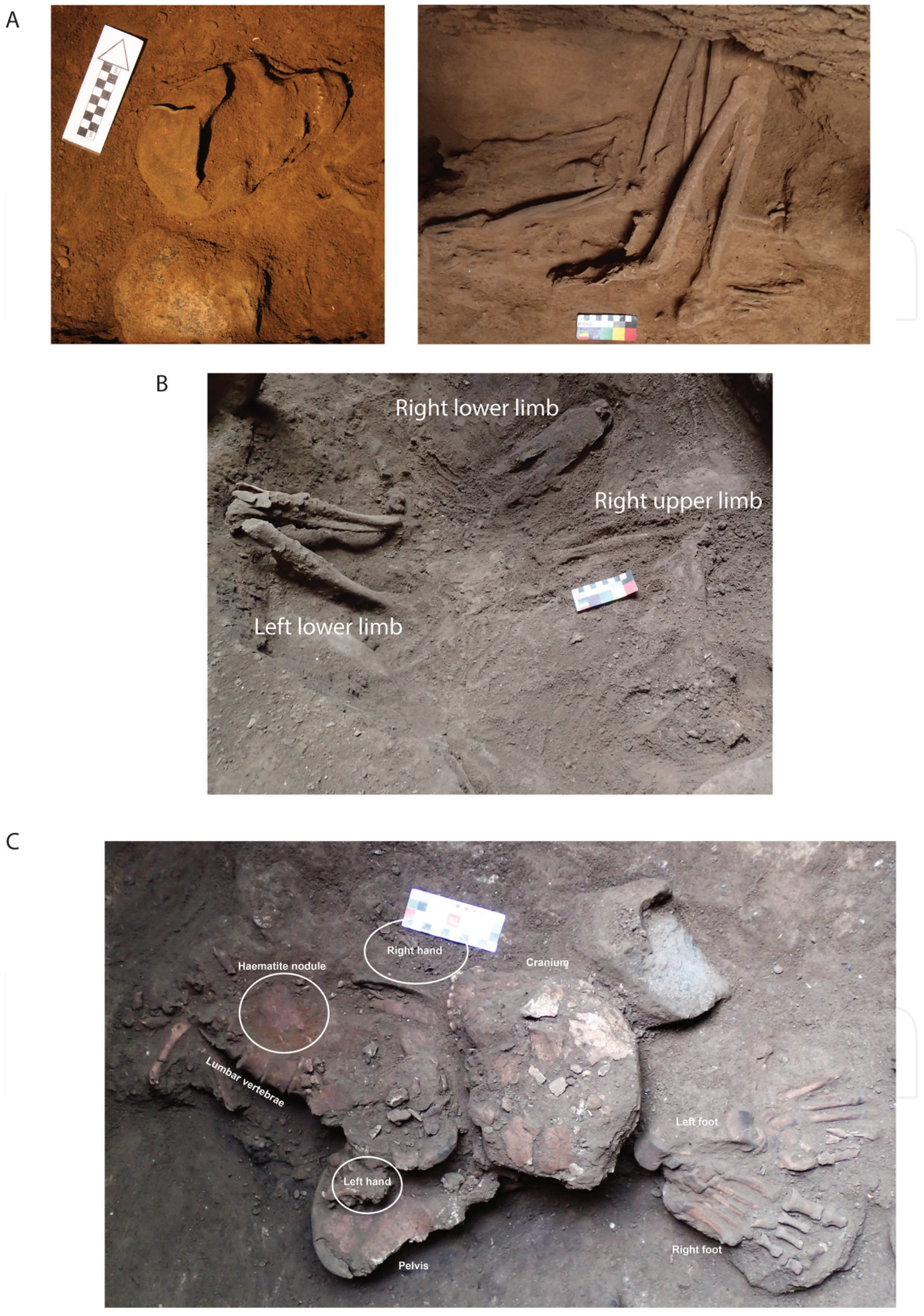

Figure 4.
Three of the human burials documented in Tron bon lei. (A) Pleistocene flexed burial, TLB-1; (B) early Holocene seated burial, DE B2. Observe vertical bended left knee; (C) middle Holocene secondary burial, E16b. Modified from figures originally published in [12] under CC BY 4.0.

3.2.3 DE B2 individual: An early Holocene seated burial

An accumulation of large rocks and cobbles was placed above a seated burial, identified based on the vertically articulated left lower limb, bended on the knee in an acute angle (**Figure 4b**). The uncommon body positioning of the early Holocene burial documented in Tron Bon Lei challenged the recovery of the remains, resulting in fragmentation of some of the lower body elements. The upper body was laying on supine position, with the articulated right arm slightly bended on the elbow (**Figure 4b**). Cranial elements identified included the mandible and a fragmentary left maxilla with dentition.

Bioskeletal profiling was limited by fragmentation. Dental wear stages indicate an estimated age-at-death of over 55 years old, while limited sexual traits suggest a female individual. No stature estimations were possible due to the fragmentation of long bones.

Grave associations include the presence of three cobbles, with one knapped and one identified as a grindstone [12]. On the base of the grave cut, a number of wedged rocks were recorded, which could have been used as support to maintain the body position, although the position of the lower limbs might have been maintained through the complementary use of wrapping or organic burial material. The position of the upper body, as well as the absence of cranium fragments, shows parallels with the decomposition patterns identified for seated burials in the prehispanic southern Andes [30].

3.2.4 E16b individual: a middle Holocene secondary burial

The most recent burial recovered in Tron Bon Lei comprises an incomplete skeleton, represented by a fragmentary skull, vertebrae, pelvis, hands, and feet (**Figure 4c**). The cranium appears in the center of the grave cut over the pelvic girdle facing north, the vertebrae to the west, hands beside the axial elements, and feet toward the east.

Even though this burial consists of comingled human remains, some of the elements appeared articulated: the thoracic and lumbar vertebrae, sacrum and coccyx, and right pelvis were in anatomical connection, with feet completely articulated.

Age estimation based on cranial suture closure and dental wear indicate an age at death of over 20 years old, coinciding with the age estimation obtained based on the pubic symphysis modification stages [12].

Pathologies identified in the E16b individual include a healed left fracture on the left scaphoid, two circular perforations on the right parietal of unknown origin, and two deep chop/cutmarks on a rib fragment [12]. The latter modifications could be related to disarticulation of the remains prior to burial.

Eight large rocks and cobbles, all with ochre applied to their surface, were placed on the edge, top or directly associated with the skeleton. A large ochre nodule appeared in situ on top of the thorax.

This burial has been interpreted as either a delayed primary burial or a secondary burial, with the distinction residing on whether the skeleton was exposed before final burial or the elements from a burial originally placed in a different location were reburied here [12].

4. Conclusion

The human remains recovered from squares B, C, D, and E from Tron Bon Lei contribute to the discussion of prehistoric migrations from the Pleistocene to the

middle Holocene in Southeast Asia. With the caveat that changes in mortuary practices indicate cultural transmission or the arrival of new populations, Tron Bon Lei provides an exhaustively dated and detailed archeothanatological study such that migratory ways and timings can be investigated.

The changes observed in burial practices in the 10,000 years' span covered by the human remains from Tron Bon Lei suggest shifts in cultural traditions, likely result of intense inter-island cultural transmission or population movements between the islands. This hypothesis can be tested with the integration of the genetic data available for the area.

Genetic data from Lesser Sunda Islands' populations highlight a complex pattern of admixture as well as evidence of ancestral genomic components in Alor modern populations [68]. Ancient genomics indicate how population migrations through Wallacea during prehistory had a two-way direction, with influxes of Papuan Ancestry westward as well as eastward genetic movement from MSEA into Wallacea [7, 8].

The significance of the human remains from Tron Bon Lei to provide evidence of these genetic movements in the Lesser Sunda Islands is remarkable. As such, the small dimensions of the Pleistocene cranial remains from squares B and C have been interpreted as indicators of relatively genetically isolated populations in the island [29]. On the other hand, the presumably secondary burial identified in square C, dated to ca. 17 ka cal BP, might reflect cultural transmission from the east (Aru Island, where the oldest secondary burial has been identified to date). Additionally, evidence for maritime transport of obsidian, and shared traditions in the manufacture of shell beads and fishhooks do not conform with the presence of an isolated population in Alor [4]. Future genetic and paleoproteomic analysis of the human remains from Tron Bon Lei might contribute to this conundrum, but until then, burial practices can contribute to the interpretation of prehistoric migrations through the comparison of burial practices through temporal and geographic scales.

The review of mortuary practices in Southeast Asia indicates that flexed burials are by far the most common burial type in the region from the Late Pleistocene onward. Currently, the earliest example of this type of internment comprises the individual from Liang Tebo (Borneo, Indonesia), which precludes the rest of burials recorded in Mainland and Island Southeast Asia by more than 10,000 years. Even though sampling issues, poor bone preservation, and dating limitations could be proposed as some of the reasons for this chronological gap, it is evident that this mortuary practice was widely spread through Southeast Asia from the Late Pleistocene, with evidence in Flores and Pantar of survival of this burial type against the expansion of extended burials during the late Holocene.

Secondary burials are relatively common in ISEA during the period of study. The human remains from square C could be characterized as a delayed primary burial or secondary burial, where selected skeletal elements were deposited after decomposition of soft tissues. Nevertheless, the absence of data regarding the spatial distribution of the remains *in situ* or an articulation assessment impedes confirming the burial type precisely. Whether the human remains from square C comprise a secondary burial, they will consist of one of the oldest internments of this type in the region, close chronologically to the Liang Lembudu burial.

Regardless of the confirmation of burial type in square C, secondary burials seem to be a mortuary practice that appears from the Late Pleistocene in ISEA, with examples of this burial type dated to the early Holocene in Java and Philippines, while evidence of this burial type in MSEA is not reported until the early/middle Holocene in the Guanxi province. Interestingly, similarities between the removal of long bones

and articulation of distal limb elements in the middle Holocene burials from Gua Makpan and Tron Bon Lei (burial E16b), as well as a similar chronology for both internments, suggest that this practice was common in Alor Island from at least the middle Holocene and also recorded in Niah cave (Borneo, Malaysia) from the early Holocene [26]. The current data for the distribution of secondary burials in ISEA are likely to indicate that this tradition originated in the eastern regions of current ISEA and later dispersed toward the western and northern regions until reaching MSEA. Future discoveries will test whether this hypothesis can be further supported.

Tron Bon Lei comprises one of the few sites in Southeast Asia where a seated burial has been documented, with the Tron Bon Lei individual (DE B2) being the oldest example anywhere in the region. Nevertheless, it is possible that some seated burials where unrecognized when originally excavated, especially in cases where the complete skeleton collapsed after decomposition due to inadequate back support. As such, some of the highly flexed burials reported from Java or Thailand could have been placed in a seated position, although this original burial position would have been impossible to identify during excavation.

As such, seated burials pinpoint the significance of conducting archeothanatological studies, as the specific ways on how these corpses will be preserved require considering several stages within the decomposition process. In other words, the absence of skeletal elements or the position of those preserved could be explained by the way seated corpses will decompose and what type of burial container was used for the deceased. A fantastic example of how considering decomposition, gravity, and infilling assist the understanding of anatomical representation was provided for Andean prehispanic burials, where the researchers were able to suggest a re-evaluation of actions involved in body preparation [30]. Nevertheless, the significance of seated burials resides in the evident pre-burial treatment required for this type of internments.

In sum, Tron Bon Lei has become a referential site to understand mortuary practices from the Pleistocene onward in the Lesser Sunda Islands, with significant implications for our understanding of prehistoric migrations in the region.

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Conflict of interest

The author declares no conflict of interest.

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