Raw Material Utilization, Technology, and Typology of Palaeolithic Tools in Myanmar: Were There Lithic Technological Links in the Regional Context?

ミャンマーにおける旧石器時代石器の原材料利用・技術・型式分類 ―石器製作技術は地域性と関係するか？―

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1. INTRODUCTION

The Palaeolithic cultural assemblage of Myanmar offers two main reasons to motivate archaeologists' interest. The first is the location of the country, which lies at an intermediate geographical position between South and Southeast Asia. Ever since scholars discovered the remains of *Homo erectus* in both China and Indonesia, Myanmar has been considered as one of the possible early human migration routes from continental to insular Southeast Asia. This was the main reason the American Southeast Asiatic Expedition for Early Man conducted work in the central belt of the country (de Terra et al., 1943: 267). Moreover, recent studies (Oppenheinmer, 2009; Marwick, 2009) based on genetic (Macaulay et al., 2005; Li et al., 2015) and geographic analyses (Field, Petraglia, and Lahr, 2007) have proposed that Myanmar was likely as one of the important routes for early human dispersal from west to southeast in Asia. The second reason is the stone tool assemblages of Myanmar themselves, since these tools are attributed to the Palaeolithic, and they play an important role in correlating archaeological data with early human activities and migration. These assemblages differ from each other in terms of their locations, raw material usage, typologies, and environmental contexts. The aim of this paper is to summarize the characteristics of stone tool assemblages in Myanmar and to examine their cultural affinities and technological links within their local and regional contexts.

2. A BRIEF HISTORY OF PALAEOLITHIC RESEARCH

Archaeological research on the Palaeolithic in Myanmar was initiated by foreign geologists who came to the country in search of oil. The first discovery of flaked stones in the central belt of the country in 1894 (Noetling, 1894) aroused controversy over whether these were natural (Pascoe, 1912) or cultural products (Swinhoe, 1903; Das Gupta, 1923; Mitra, 1927; Morris, 1935). Pascoe (1912) claimed that the evidences are not enough to prove the existence of early man and thought as an improbable consideration. Among the scholars who accepted the flaked stones as artefacts, Das Gupta examined the Noetling's collection and convinced them as cultural product. Mitra also accepted the flaked stones as human workmanship (Brown, 1931). However, their descriptions were unconvincing answers among the scholars. Therefore, Brown (1931) pointed out the whole question on the authenticity of evidence suffers from too much writing on too little evidence. The controversy prompted scholars to conduct further archaeological studies on stone tools in the country. Morris attempted to assign the cultural levels of stone, copper and iron artefacts in terms of associated stratigraphy between 1932 and 1937. Nevertheless,

such designations on the whole cultural sequences are not possible to accept because the artefacts are not only found in a specific region, but also all over the country. In 1938–39, considering Myanmar as an important geographic location, the above-mentioned American expedition conducted extensive survey work along the Ayeyarwady river in the central belt and in some localities on the Shan plateau, which yielded several hundreds of stone artifacts and fossilized remains of mammals and mollusks. It also revealed Pleistocene geological terraces and established the Palaeolithic culture of the country, known as the Anyathian. Movius used a stratigraphic approach to estimate the dates of the artfacts, articulating Anyathian culture as belonging from the Middle Pleistocene to early Holocene (de Terra et al., 1943: 341), and the expedition's work still largely influences local archaeologists. Subsequently, research in stone tool archaeology halted for over two decades as researchers focused mainly on monumental remains of the historical period (Aung-Thwin, 2001). In 1969, it was renewed with the discovery of a prehistoric cave at Badahlin (formerly spelled Padahlin) in Shan State. Aung Thaw unearthed some hundreds of stone artifacts, animal remains, charcoal, potsherds, and red ochre. The cave also possesses nearly a dozen wall paintings of figures mostly depicting animals and human hands. One radiocarbon date for the site goes back to 13,400±200 BP (Aung Thaw, 1971) for its earliest occupation (the youngest age is 1750±81 BP). The artifacts give evidence that in contrast with the Anyathian in the central belt, a stone tool culture might have been well developed in the eastern part of the country by the early Holocene.

From the 1970s onward to 2000, archaeological investigations provided momentum for research on stone tool archaeology with projects carried out in the central belt and Shan State (see Table 1). Among them, three research projects aimed to reinvestigate the Palaeolithic culture of the central belt. Since all Anyathian artifacts, now displayed in the Peabody Museum in the United States of America, had been taken back by the American expedition, there was no concrete evidence of Palaeolithic culture in Myanmar except for accounts in the literature. Accordingly, Win Kyaing and his colleagues carried out work at the sites discovered by the American expedition and also identified some sites exhibiting Anyathian cultural features to the south of central belt (Win Kyaing, 2010a, 2010b). He notes the Anyathian cultural sphere was probably more extensive than previously thought. On the other hand, while good evidence of faunal remains associated with stone artifacts were provided by excavations at cave sites in the Shan plateau, these results faced challenges in gaining the attention of international scholars because they mostly depended on relative rather than absolute dates, and were also written in the local language. Nevertheless, these data can contribute to a better understanding of early human activities and economy.

3. THE ENVIRONMENTAL SETTING

Although there is no direct evidence for environmental conditions of the Pleistocene and early Holocene of the country, the Quaternary environmental background can be partially presumed through geological and

geographical studies of such scholars as Chhibber (1934), Davis (1960), and Bender (1983). The physiography of Myanmar is generally divided into four main parts, the central belt, the Shan highland, the western mountain belt, and the Arakan coastal strip, and each region has its unique configuration of altitude, geological features, local climatic variations, and forest types (Chhibber, 1934: 1–2; Huke, 1965: 4–7).

Stone age sites attributed to the Palaeolithic period have been discovered in the former two regions, the central belt and Shan highland, in other words in both lowland and upland karstic regions (see Map 1). There is some information about Neolithic artifacts in other regions, but archaeological investigations cannot be conducted as easily as in the former two regions. Since the central belt is alluvial lowland while the Shan highland is an upland karstic region, their elevations totally differ. The lowland area divides into various subtypes of dry scrub forests and semi-desert scrub vegetation (Bender, 1983: 12). In contrast, the upland karstic region has a subtropical monsoon and subtropical mountain climate. Additionally, there is a tropical moist forest between the lowland and upland regions (Davis, 1960: 7), with two Palaeolithic sites falling in the area of this vegetation. Most of the sites in the lowland area are located close to main water resources, whereas those in the upland karstic region are at some distance from seasonal streams.

The open air sites discovered so far are the dominant settlement type in the central belt, which itself is surrounded by the Shan highland to the east and the western mountainous region to the west. Its basic lithology is sandstone, shales, and clays (Chhibber, 1934: 1–2). A recent lithological study of the region describes an abundance of fossil wood (Licht et al., 2014). This supports Movius's claim (deTerra et al., 1943: 349) for the availability of fossil wood as one of the main raw materials in the area for the production of stone tools. Moreover, it seems that silicified tuff, which develops through a process of fossilization from volcanic rock, also might have been used as a raw material source by the stone tool makers (de Terra et al., 1943: 349). Generally, the lowland area is about 50 m above sea level and its climatic condition ranges from tropical steppe to semi-arid (Bender, 1983: 12), receiving less than 1,016 mm precipitation per annum (Davis, 1960: 7). The Shan highland is generally composed of massive deposits of limestone, sandstone, metamorphic rocks, and granite (Huke, 1965: 4–7), and cave sites are located in this region at about 1,300 m in elevation, with an annual precipitation over 1,524 mm (Davis, 1960: 7). However, stone tools from both regions show a common use of igneous rocks and quartzite, demonstrating that these rock types were available and utilized not only at open air sites but also at cave sites. Accordingly, these two different ecological orientations provide moderate grounds for speculation about the Quaternary climate and the availability of raw material sources. It is necessary to understand the nature of these two regions where two different stone tool traditions have been found, in order to see, in other words, how different habitational patterns arose in response to different varieties of local environment.

4. CHRONOLOGY, CULTURE, AND STONE TOOL TYPOLOGY

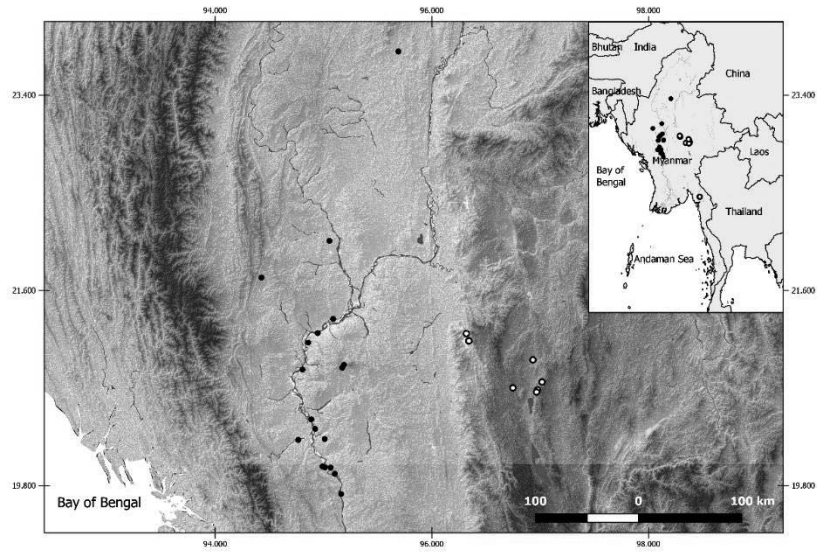
4.1 Anyathian culture in the central belt

The most interesting and important questions raised about the Palaeolithic culture of Myanmar concern its chronology. Movius established a time line for Anyathian culture from the Middle Pleistocene to the Holocene in terms of old river terraces of the Ayeyarwady (de Terra et al., 1943: 343–347; see Figure 1 and Map 2). This has mostly convinced scholars although some have modified the dates by comparison with others from Southeast Asia (Than Tun, 2004: 20–33; Moore, 2007: 50–51). On the other hand, Hutterer (1977) and Dennell (2014) criticize Palaeolithic artifacts collected from the surface of sites, especially fossil wood, as likely to be natural items and their stratigraphic value for a cultural time line as uncertain.

Contributor	Site	Location	Date	Findings	Source
Noetling	Yenangyaung	Magway	1894-1897	Palaeolithic Tools made of flint (?)	Noetling 1894, 1897
Morris	Yenangyaung and its surrounding	Magway	1932-1935	Palaeolithic Tools	Morris 1932, 1936
Movius	Ayeyarwady valley and Shan	Magway, Mandalay and Shan	1937-1938	Palaeolithic and Neolithic tools	Movius 1943, 1948
Aung Thaw	Badahlin	Shan	1969	stone tools, Red Ochre, Wall Paintings, potsherds, faunal remains	Aung Thaw 1971
Myint Aung	Mt. Natlin	Sagaing	1975	Upper Palaeolithic Tools	Myint Aung 2012
Ba Maw	Moegyobyin and Nwe Gwe	Sagaing	1995-1998	Palaeolithic, Mesolithic and Neolithic Tools	Ba Maw 1995, 1998; Than Tun Aung 2002; Nwe Nwe Moe 2014
Tin Thein	Cave sites	Shan	1997	Palaeolithic and Neolithic tools and faunal remains	Tin Thein 2011
Tin Thein	Waiponla	Kayin	2000	Upper Palaeolithic tools and faunal remains	Tin Thein 2000, Tin Thein et al 2001, Tin Thein 2011
Tacon et al	Badahlin	Shan	2004	Cupules and new rock art figures	Taçon et al 2004
Win Kyaing	Pauk	Magway	2005	Palaeolithic tools	Win Kyaing and Aung Naing Soe 2005
Win Kyaing	Ayeyarwady valley	Magway and Mandalay	2008-2009	Palaeolithic tools	Win Kyaing 2010a, 2010b
Ye Myat Aung	Badahlin	Shan	2009	Stone tools	Ye Myat Aung 2009
Kyaw Khaing	Cave sites	Shan	2012	Stone tools and faunal remains	Kyaw Khaing 2012

Table 1 Summary of research in Palaeolithic archaeology in Myanmar

They also point to the lack of scientific calibration for dates of the sites, although they acknowledge this was acceptable given the state of scientific technological development for dating in Movius's time. While their criticisms are generally reasonable, one should not forget that reliance on geological stratigraphy for dating sites is still useful in Asian countries with limited research funding for scientific dating (Ramesh, 1986; Forestier et al., 2014). At the same time, it seems that these critics are not well informed about other Palaeolithic tools made of silicified tuff and igneous rock, and also about recent studies carried out by local archaeologists. Therefore, use of the term "Palaeolithic" based on typology and the associated geological chronology established through recent studies is generally believed to be convincing.



Map 1 Distribution of main Palaeolithic sites in the lowland and the upland karstic region. Black and white dots represent open air sites and cave sites respectively.

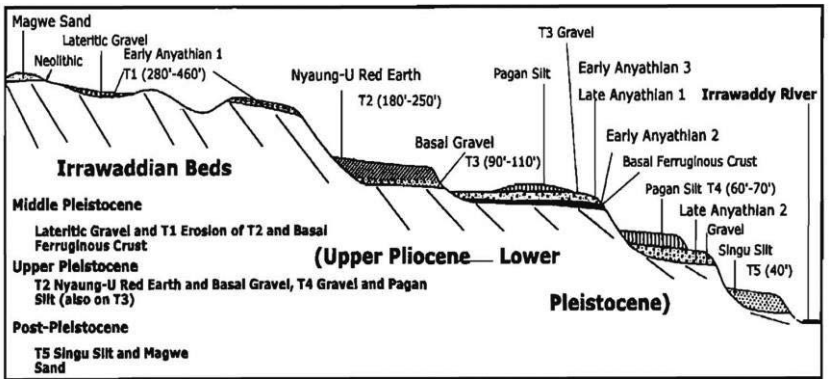


Fig 1 Soil deposits and terraces of Ayeyarwady river and the associated cultural phases (After Movius et al 1943 and modified by Aung Thwin 2001)

Anyathian culture, as mentioned above, is a Palaeolithic stone tool culture that mainly used fossil wood, silicified tuff, and some igneous rock, spanning from the Middle Pleistocene to the early Holocene. It can be divided into two main phases, Early and Late, with three subphases for the former and two subphases for the latter. These cultural phases are divided in terms of their associated geological terraces and the typology of the tools. The Early Anyathian Phase (EAP) belongs to the Early and Middle Palaeolithic periods, while the Late Anyathian Phase (LAP) extends to the Upper Palaeolithic period (see Figure 2). The dominant types of stone artifacts

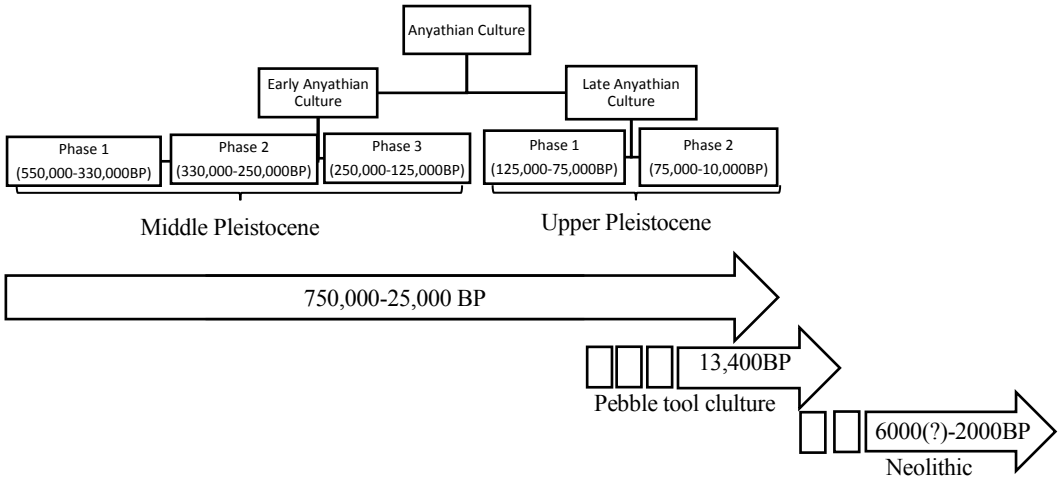
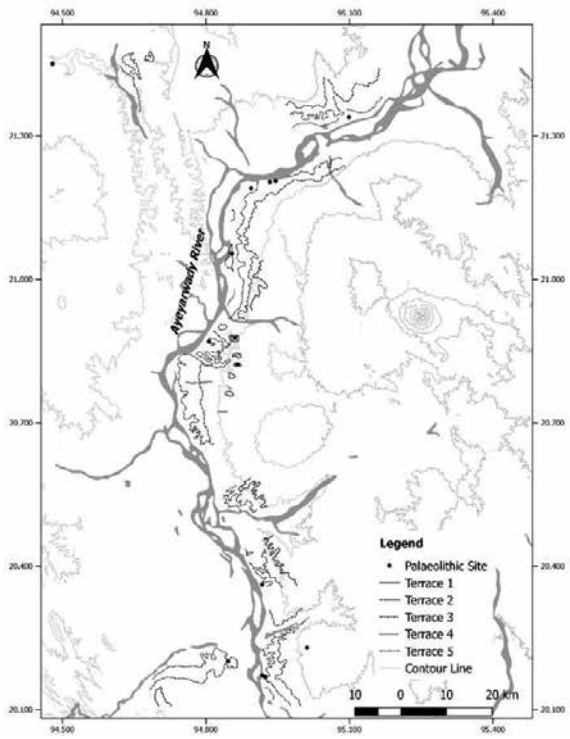


Figure 2 Schematic diagram of Palaeolithic to Neolithic in chronological order (based on de Terra et al., 1943, Aung Thaw, 1971, Than Tun, 2004, and Moore, 2007. Note: Anyathian dates shown are not absolute dates but estimates made by the latter two authors)



Map 2 Palaeolithic sites and associated geological terraces (adapted from de Terra et al., 1943). Note: Geological terraces without lines are omitted.

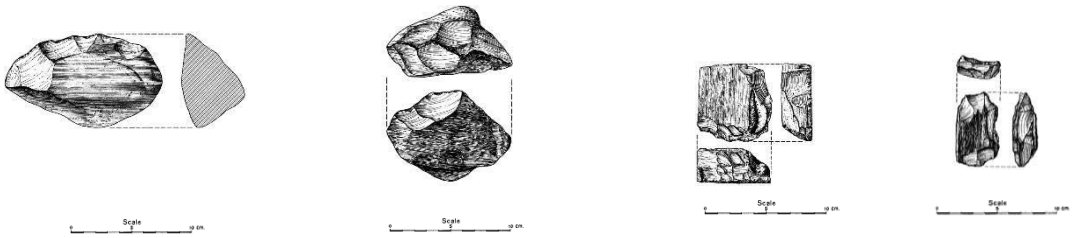


Figure 3 Anyathian tools from left to right: chopper, chopping tool, hand adze, and scraper (after de Terra et al., 1943)

Figure 4 Some replicas of Anyathian stone artifacts now displayed at the museum of the Archaeology Department, University of Yangon

are choppers, chopping tools, hand adzes, and scrapers (see Figures 3, 4, and 5) with morphological variations. According to the typology, as defined by Movius, a chopper has either a rounded, semi-oval, or almost straight cutting edge formed by flaking on the upper surface, while chopping tools have a sinuous, bifacially flaked working edge. A hand adze is another type of chopper, which is a tabular form with a straight, slightly rounded, or pointed cutting edge. Smaller choppers become scrapers made on flakes from a core. Movius commented that the Anyathian culture has a homogeneous nature as a chopper-chopping tool tradition with an absence of hand axes or bifacial tools, reflecting technological stagnation throughout he cultural sequence (de Terra et al., 1943: 351–74). However, as noted by Dennell (2014), his statement about not adopting hand axes as indicating cultural retardation needs to be reconsidered.

On the other hand, recent field work has yielded several hundreds of Anyathian artifacts from the old terraces of Ayeyarwady river and archaeologists have also noted that these tool collections are largely dominated by four main types of stone artifacts, as mentioned by Movius. Although they found one or two additional examples of

bifacial tools or hand axes (Win Kyaing, 2010b), generally these two are negligible in quantity when compared with other types.

In order to know the difference between each typology, in this study 101 artifacts were randomly selected out of over 750 examples (see Figure 5) for analysis based on their reported dimensions. These artifacts are mainly core tools with characteristic crude flaking on the edge and made of fossil wood, silicified tuff, igneous rock, and quartzite. They were collected in recent field work by Win Kyaing and his colleagues in 2008 and 2009 from five typical Anyathian sites, namely Bagan, Chauk, Nyaung U, Yenangyaung, and Pakokku, and the three sites of Gwe Chuang, Minhla, and Sinbaungwe, that are located in the same geological context as the former group. These artifacts are now stored at the Field School of Archaeology (in Pyay). All metric data were taken in millimeters for the three variables of length, width, and thickness. Admittedly, this study may not encompass the entire Anyathian tradition of the central belt, but it is hoped to give a partial understanding of changing tendencies of the artifacts.

In this study, fossil wood (n = 59) dominates throughout followed by silicified tuff (n = 28), while examples of igneous rock (n = 10) and quartzite (n = 4) are the fewest (Figure 6). This shows that while all of these materials were used in the EAP, only fossil wood was used in the LAP. Since some artifact types are not represented in every cultural subphase, the two main phases of Early and Late are used to show how they differ over time for each dimension (Figure 7). Additionally, the variable of length shows the most conspicuous difference among the cultural phases, although width and thickness do not go similarly from larger to smaller when studied according to phase. It is remarkable how the dimensions thus show significant differences when subphases are combined into the two main cultural phases. Chopper and chopping tools are the largest items in the typology and there is not much difference between them in terms of the variables. However, it is remarkable that hand adze length is greater than the two variables of width and thickness. In the scraper group, width is greater than length and thickness. Therefore, this study shows that choppers and scrapers as well as chopping tools and hand adzes are generally different only in size, as noted by de Terra et al. (1943: 351). On the other hand, these four main types of the artifacts differ in size according to the phase.

Figure 5 Some stone artifacts from recent field work of 2008 and 2009 (left to right: hand adze, chopping tool, chopper, and hand adze)

4.2 Pebble tool culture in the upland karstic region

Aung-Thwin uses the term post-Anyathian culture as corresponding to late Hoabinhian for cave sites in the Shan highland (Aung-Thwin, 2001). In fact, late Hoabinhian sites often contain a quantity of potsherds and a few chipped hand adzes whose working edge is only polished and grounded (Solheim, 1972). Most of the cave sites in Shan highland do not match with this criterion, except for Badahlin. Therefore, it is better to use the term "pebble tool" culture since it is mainly based on the tools abundantly found in those sites in the Shan highland or karstic region. The caves sites from karstic region give invaluable zooarchaeological evidence suggesting the

Topography	Lowland plain (nearby main water resources)	Upland karstic region (some distance from water sources)
Sea Level	ca. 50m	ca. 1300m
Raw Material	Fossil wood, silicified tuff, chert, basalt, igneous rock and quartzite	Limestone, sandstone, granite, rhyolite, siltstone, andesite, igneous rock and quartzite
Artefact	Chopper tool, chopping tool, hand adze, scraper	Hand adze, unifacial bifacial chopping tool, scraper, mullers, hammerstone
Ecofact	-	Faunal remains
Typology	Crude and massiveness	Flaked pebble tools, advanced in type and effective edges
Culture	Anyathian Culture	Pebble tool culture (Hoabinhian?)
Period	Middle Pleistocene-Early -Holocene(?)	From 13,000 BP?

Table 2 Different characteristics of two stone tool cultures in Myanmar

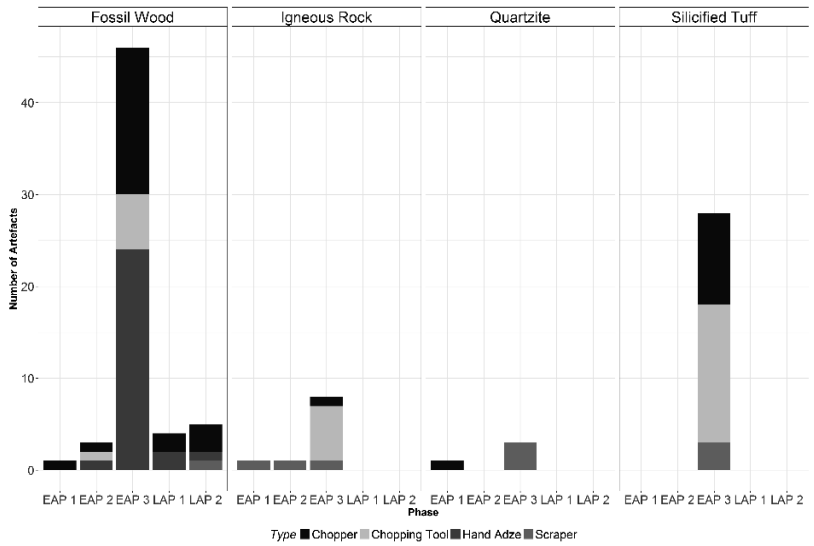
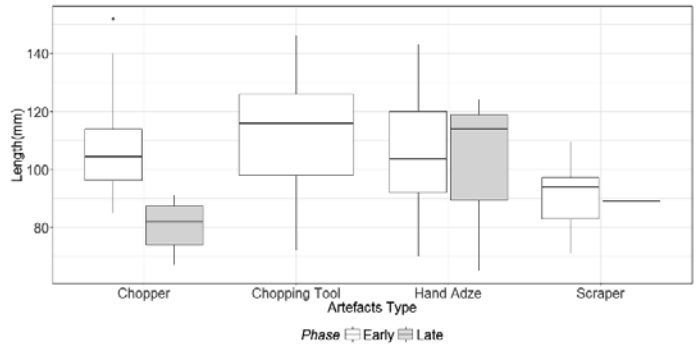
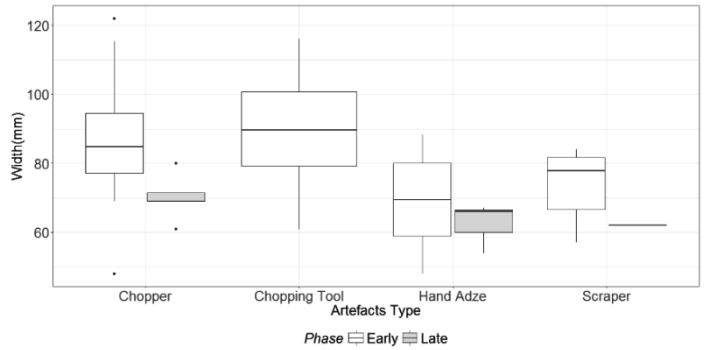


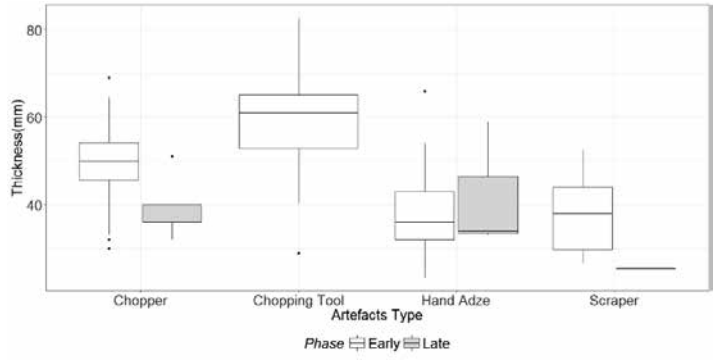
Figure 6 Types of raw material in accordance with their cultural phases. EAP 1 = Early Anyathian Phase 1; EAP 2 = Early Anyathian Phase 2; EAP3 = Early Anyathian Phase 3; LAP 1 = Late Anyathian Phase 1; LAP 2 = Late Anyathian Phase 2.



(a)



(b)



(c)

Figure 7 Different dimensions of the stone tool types in the Early and Late cultural phases. (A) Length. (B) Width. (C) Thickness. Early = Early Anyathian Phase; Late = Late Anyathian Phase.

Figure 8 Some pebble tools from Badahlin cave (top row from left to right: bifacial tool, bifacial tool, chopper, chopper; bottom: scrapers)

subsistence pattern of early human economy. However, Badahlin cave is the only site among these dated by radiometric calibration. Hence, the tools from Badahlin and the Anyathian culture are the main basis for suggesting the chronology and cultural features of other stone age sites in the country. Most of the stone tools from these caves sites are totally different from Anyathian culture. These tools were made of limestone, sandstone, granite, rhyolite, siltstone, andesite, igneous rock, and quartzite (Figure 8). The general characteristics of tools from the karstic region are more advanced in typology and they also have a more effective working edge. Moreover, more advanced and new types of stone artifacts are also found, such as mullers and mace heads, bifacial tools (Aung Thaw, 1971), and hand axes (Tin Thein et al., 2001). Aung Thaw argues stone artifacts from Badahlin can be comparable to Hoabinhian from a typological point of view (Aung Thaw, 1971). Myint Aung (2012) also asserts that the cave shares common features of Southeast Asian Hoabinhian characteristics. However, how these tools are similar and different from Hoabinhian remains in question and more evidence is needed to appraise these two cultures. Therefore, the above-mentioned facts indicate only that the stone tool cultures from the lowland area and upland karstic region are totally different from each other (see Table 2).

5. STONE TOOL CULTURES AND THEIR LINKS IN REGIONAL CONTEXT

An important question for the Myanmar Palaeolithic is how its stone tool cultures relate with others in a regional context. Movius inserts Myanmar into the territory of the chopper-chopping tool complex of Eastern Asia due to morphological similarities with other industries such as the Soanian in Pakistan, Zhoukoudian in China,

Pacitanian in Indonesia, and Tampanian in Malaysia (de Terra et al., 1943: 372). Although the raw materials of those culture mostly differ from each other, recent studies show some localities where fossil wood artifacts are found in regions of India (Hazarika, 2013), Bangladesh (Ramesh, 1986), Thailand (Reynolds, 1990), Cambodia (Forestier et al., 2014), and even Indonesia (Soejono, 1961). It is noteworthy that no scientific dating is available except for Bangladesh. Its radiocarbon date shows the Upper Palaeolithic-Neolithic as 3,450±110 BP whereas the late Middle Palaeolithic is 35,690±3,050 BP (Hazarika, 2012). Chakrabarti (1997) concluded that the artifacts from Lalmai-Tripura have a close affinity with those of the second subphase of the Late Anyathian. Hence, there might have been some connections through either technology or migration among these localities. Or perhaps these localized communities received the same outside knowledge for using fossil wood, abundantly found in their surroundings, as a raw material.

With regards to the pebble tools from the upland karstic region, no typical sumatralith nor bone tool was reported from excavations at the cave sites, and hence it is hard to say that these stone artifacts are comparable to Hoabinhian culture. However, some faunal remains (Hla Gyi Mg Mg, 1998; Tin Thein, 2011; Kyaw Khaing, 2012) are admittedly the same as those of typical Hoabinhian sites (Gorman, 1971; Conrad, 2015). The most exploited faunal remains at the sites are mollusks, eld's deer (*Rucervus eldi*), wild boar (*Sus scrofa*), cattle/buffalo (*Bovidae sp.*), sambar deer (*Rusa unicolor*) and rhinoceros (*Rhinocerotidae*). Moreover, several species of *Bovidae*, *Cervidae*, *Felidae* and primates were also discovered at the sites. Therefore, it seems that all sites of mainland Southeast Asia shared common climatic conditions in the Pleistocene and early Holocene. Further work is needed to examine the cultural connections of the sites from the karstic region within the local and regional contexts.

6. CONCLUSION

In conclusion, there are two kinds of geographical settings for Palaeolithic sites in Myanmar, the lowland area and the karstic region. In dealing with Palaeolithic chronology, while it lacks concrete dates, we can see tools that are rather crude, massive, and showing a very fundamental flaking technique becoming established in the lowland area. In contrast, the pebble tool culture from the cave sites in the upland karstic region reflects totally different cultural features. These artefacts are more advanced in technique and seem more effective in function. Different backgrounds of environmental and geological settings may have promoted the establishment of these different stone tool traditions. In addition, recent genetic analyses (Macaulay et al., 2005; Li et al., 2015) propose an early human dispersal movement at about 44,000–63,000 BP in the western coastal region, and a possible dispersal movement around 25,000–10,000 BP in the east, to southwest China. These human migrations may have affected technological distributions in various regional contexts. However, even if these dispersal movements can be proved genetically, they cannot yet be confirmed archaeologically. Therefore, further analyses

and studies of stone tool assemblages of Myanmar are needed to document human dispersal routes and technological connections within both local and regional contexts.

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ミャンマーにおける旧石器時代石器の原材料利用・技術・型式分類
—石器製作技術は地域性と関係するか？—

要　旨

ミャンマーの旧石器文化はその地理的位置によって二つに区分される。開地的な遺跡は低地平原に位置し、そこで典型的なアニャティアン文化が更新世中期から完新世前期の間に盛行したものと思われる。一方、高地カルスト地帯の洞穴遺跡は礫器文化を反映しており、その年代は 11,000 BP ごろ以降に始まるかもしれない。本論はそうした二つの異なった文化の特徴をまとめるとともに、地方的・地域的伝統における技術論的関連を明らかにしようとするものである。

キーワード：　旧石器、アニャティアン文化、ミャンマー