Bose and An Khe Industries and Relevant Issues: A Comparative Study

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Abstract: The Palaeolithic industry in the Bose (Baise) Basin, Guangxi, South China, is well-known in the international scientific community for its handaxes dating back to the early Middle Pleistocene. In recent years, a bifacial industry has been discovered in An Khe, Gia Lai Province, located towards the southern part of Vietnam, which has been dated to 806ka BP. The Bose and An Khe bifacial industries are important in the study of Lower Palaeolithic cultures of East and Southeast Asia. This paper presents a comparison of these two industries, and discusses some related issues.

Keywords: Bifacial industry, cultural comparison, Lower Palaeolithic, southern China and Southeast Asia.

Subject classification: Archeology

1. Introduction

Handaxes are the most typical tool in the Acheulean industrial complex, and they have been widely discovered in East and Southeast Asia **(**Figure 1). In China, handaxes have been found in: the Bose (Baise) Basin in Guangxi (Huang, 1987 and 1993; Hou, et al., 2000; Xie, 2002; Xie, et al., 2003; Xie and Bodin, 2007; Xie and Lin, 2008; Wang, et al., 2008 and 2014; Zhang et al., 2010), the Lishui area in Hunan Province (Huang, 1987 and 1993; Wang, 1997), the Danjiangkou Reservoir Region (DRR) in Hubei Province (Li, et al., 2009, 2012, 2013, 2014a, 2014b and 2017), Dadong cave in Guizhou Province (Huang, et al., 2012), the Luonan and Hanzhong Basins in Shaanxi Province (Huang and Qi, 1987; Wang, et al., 2005; Lu, et al., 2006; Wang, 2005, 2010 and 2014; Xing, et al., 2015), the Dingcun site in Shanxi Province (Huang, 1987), the Shuiyangjiang area in Anhui Province (Dong, 2020), and the Nanjiang Basin in Guangdong Province (Liu, 2015 and 2017) (Figure 1). Handaxes have also been

recovered from many Palaeolithic sites in the Republic of Korea, especially in the Imjin-Hantan River Basins (IHRB) (Norton, 2000; Norton, et al., 2006; de Lumley, et al., 2011). In Southeast Asia, more and more handaxe-yielding sites have been identified since the Pacitanian site in Indonesia was first discovered (Movius, 1948). They include various Indonesian sites (Simanjuntak, et al., 2010), Bukit Bunuh in Malaysia (Saidin, 2006), and the Arubo site in Luzon, Philippines (Pawlik, 2002). In Vietnam, handaxes have not only been found at Nui Do, Thanh Hoa Province (Ciochon and Olsen, 1986; Olsen, et al., 1990), but also in recent years at An Khe, Gia Lai Province, north of southern Vietnam which may be the most important Palaeolithic discovery in Southeast Asia during the first two decades of the 21st century (Nguyen, et al., 2015; Nguyen, 2017; Derevianko, et al., 2016 and 2018).

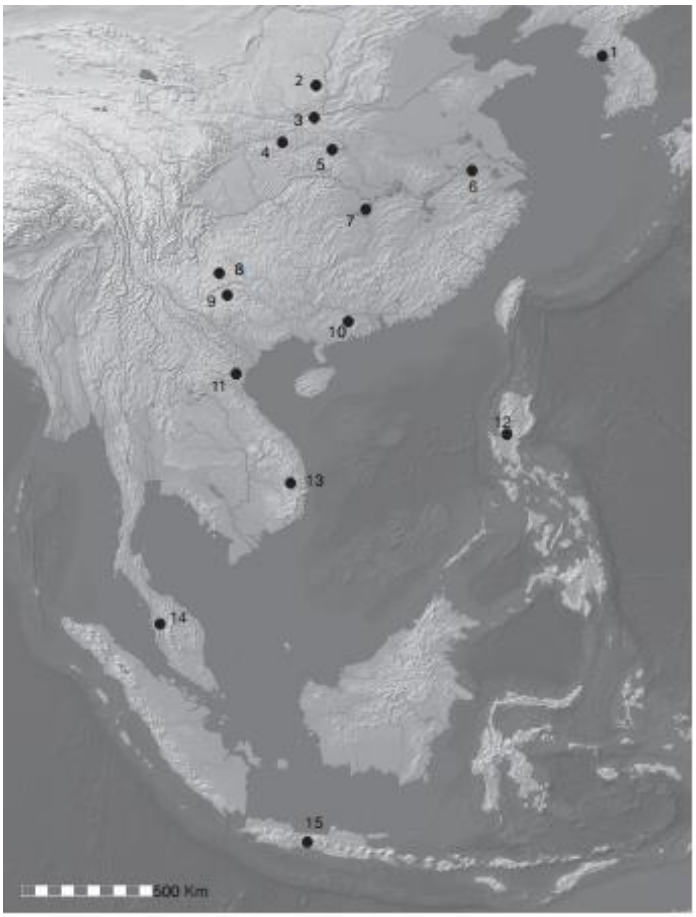
Comparative studies of the bifacial industries east and west of the Movius Line, have been conducted by many scholars (Schick, 1994; Hou, et al., 2000; Leng and Shannon, 2000; Norton, 2000; Keates, 2002; Corvinus, 2004; Wang, 2005; Norton, et al., 2006; Lycett, 2007; Lycett and Gowlett, 2008; Wang, et al., 2008 and 2012; Norton and Bae, 2009; Petraglia and Shipton, 2009; Brumm, 2010; Lycett and Bae, 2010; Lycett and Norton, 2010; Norton and Lycett, 2010; Shipton and Petraglia, 2010; Bar-Yosef, et al., 2012; Dennell, 2016). There are two points of view on the origin of bifacial tools found in East and Southeast Asia. One is that they arose from the cultural exchange between east and west, with the bifacial industry in the east originating in the Acheulean Complex (Huang, 1993; Li, et al., 2014a and 2014b; Kuman, et al., 2014; Wang, 2005; Dennell, 2016). The other is that the bifacial tools from the east developed independently as a phenomenon of cultural convergence (Lycett, et al., 2008, 2010a and 2010b; Norton et al., 2009 and 2010; Gao, 2012). However, no attempt has yet been made to undertake a comparative study of the bifacial industries that existed within East and Southeast Asia; hence, the relationship between these industries remains unclear.

The Bose industry of the Middle Pleistocene period is the best-known bifacial industry in eastern Asia, while the An Khe industry is one of the most important bifacial industries in Southeast Asia. In this paper the author presents a comparative study of the Bose and An Khe industries and discusses some related issues.

2. The Bose industry

The Bose Palaeolithic sites are located in the Bose Basin in the western region of the Guangxi Zhuang Autonomous Region (GZAR), southern China (23°33'-24°18' N, 106°7'-106°56' E) (Figure 1). Since the first site was discovered in 1973, more than 110 additional sites of the Bose Palaeolithic industry have been identified, 20 of which have been excavated, leading to the recovery of over 20,000 stone artefacts. Based on dating tektites found in situ, in association with handaxes and other stone artefacts, the industry has been dated back to 803 ka (Li, et al., 1975; Qin, et al., 1983; Zeng, 1983; Huang, et al., 1990 and 2012; Hou, et al., 2000; Xie, et al., 2003, 2008 and 2010; Xie and Bodin, 2007; Pei, et al., 2007; Zhang, et al., 2010; Wang, et al., 2014).

Figure 1: Main Sites, for East and Southeast Asia Where Handaxes and Other Large Cutting Tools Have Been Identified Thus Far



Notes: 1. IHRB; 2. Dingcun; 3. Luonan; 4. Liangshan; 5. DRR; 6. Shuiyangjiang; 7. Lishui; 8. Dadong; 9. Bose (Baise); 10. Nanjiang; 11. Nui Do; 12. Arubo; 13. An Khe; 14. Bukit Bunuh; 15. Ngebung and Pacitanian.

Source: Map by C.F.W. Higham.

2.1. Geological background

The Bose Basin, covering 800km^2, is surrounded by low elevation mountains ranging between 500m and 1,500m above sea level. The basin is dissected by the Youjiang River flowing from northwest to southeast. Seven river terraces dating back to the Late Pliocene and Pleistocene are associated with uplift of the Qinghai-Tibetan Plateau (Yuan, et al., 1999). Terrace 1 (T1) has the most extensive and stable stratum. The upper part of T1 contains Neolithic artefacts, such as those found at the Gexinqiao site (Xie, et al., 2003), suggesting that the age of T1 should be dated to terminal Pleistocene and/or Early Holocene. The second and third terraces (T2 and T3) are also exposed across the basin, but not as extensively as T1 or the fourth terrace (T4).

Palaeolithic deposits have been identified in both T2 and T3 (Xie, 2015). T4 is the best-known due to the appearance of handaxes within its tektite-bearing deposits. It is comprised of an upper sedimentary unit 7m to 10m thick with poorly-developed latosols underlain by reticular mottled red clay, typical of laterites, and a lower unit 5m to 20m thick with well-sorted cobble conglomerate. Three additional platforms have been identified on the higher elevations of the surrounding hills. These consist of gravel beds that unconformably overlie the Eocene beds, and dispersed pebbles and fragments of iron pan and tubercular iron-manganese. They may have developed at the end of the Pliocene and represent the earliest terraces in the basin (Yuan, et al., 1999; Huang, et al., 2012; Xu, et al., 2012).

2.2. Stone artefacts

Stone artefacts from Bose include cores, flakes, choppers and chopping tools, handaxes, picks, scrapers, cleavers, hammers, and chunks. In terms of raw materials used for tool making, cobbles mainly of quartzite and sandstone, came from the Youjiang River valley. Most tools that had been manufactured on cobbles, whose shapes were selected in order to simplify the manufacture of the desired final form. As a result, there are many tools that are only partially worked, as demonstrated by large areas of cortex. Direct hammerstone percussion and direct anvil technique (block-on-block) were used in tool production. Apart from handaxes, tools that have been discovered are mostly those that have been unifacially flaked and retouched (Figures 2 and 4).

Raw materials

Raw materials used for tool making are almost always quartzite or sandstone cobbles, which are found in abundance in the basal conglomerates of terrace five (T5) through to terrace seven (T7) in the Youjiang River valley, followed by quartz, silicified rock, chert, and (more rarely) basalt. In most cases, the materials are inferior in quality due to the existence of many faults within the rock. In particular, quartz, or cobbles had been weathered before they were used for tool making. These factors played an important role in the technology of tools. Selectivity can be seen in regards to raw materials, which vary according to tool type.

Flakes and cores

Flakes are rare, and contrast with the tool types. Some flakes might have been by-products of tool making as many of them are amorphous. Most are 3cm to 5cm in length; there are also some large, even massive flakes (over 20cm). The large size of some flakes and the absence of a bulb of percussion indicate that the anvil technique had been used. None of the flakes show any indication of platform preparation, and more or less cortex remains on the dorsal surface, especially with regards to the large flakes. The dorsal surfaces of the flakes, especially the small ones, normally have flake scars, which indicates they would have usually been struck from the same direction as the flake itself. The large flake edges commonly show definite wearing, while it is rare to find retouched flakes.

Cores are also scarce; however, those that do exist tend to be large, while some are even enormous. This is consistent with

the flakes. The most common are those with one or two platforms. The utilization rate of cores is low, and general pebble cortex remains on the surface. This is confirmed by the flake's dorsal surface with surviving cortex.

Choppers

Choppers are the most common implement, forming 37.8% of the total of the stone artifacts. Nearly all were made from cobbles. In most cases, flaking is characterised by large flakes and fairly regular but stepped scars. The tools have large unflaked surfaces, which exhibit the original exterior cortices of the cobbles. Both unifacial and bifacial types are found. The former are far more numerous than the later bifacial ones, accounting for 95% of the total. Most of the choppers are 12cm to 16cm long and weigh 1,000g to 1,500g. The unifacial types are likely to have been fashioned on cobbles with a flat surface left unflaked. Some retouched scars are visible on the working edges, but few used traces are observed. Single-edged choppers are the most numerous, accounting for 82% of the total (Figures 2 and 3).

Handaxes

Handaxes are not many, comprising 6.6% of the lithic assemblage. Raw materials are mainly quartzite and sandstone. They vary between 10 cm and 18cm in length, and weigh 500g to 1,000g. Handaxes made on cores (cobbles) are much more in number than those made on flakes. Knapping and trimming technology are Acheulean-like. Flake scars are shallow. The presence of a cortical surface near the butt end is also common. Their edges are straight or just with a slightly zig-zag course. The lower end often displays a thick "butt". Subtypes are triangular, elongate ovate, lanceolate, cordiform, kidney-form, and ovate. The triangular form is common, followed by elongate ovate. Cross sections are triangular, plano-convex, bi-convex, and trapezoid. Triangular and plano-convex forms dominate. In general, Bose handaxes are characterised by simple modifications, stepped flake scars, and relatively large thick cross-sections. This is due mainly to the cobbles being composed of coarse-grained material with many textures, and in some cases, weathered before the cobbles were used for tool making, (see 3, 5, 6, 9 of Figure 2)

Picks

Picks are characteristic of the Bose industry, and account for a large number in the lithic assemblage (18.0%). Many are very similar to handaxes in terms of material, shape, and size except that the former are unifacially flaked while the latter are bifacial. In fact, picks with shallow scars and thin tips are virtually identical to the unifacial handaxes found in Africa (Beyene, et al., 2013; Kuman, 2019). Nearly all of them would have been made on cobbles and, in most cases, worked on the upper surface only. They have plano-convex or triangular cross sections and tips are often tongue-shaped. Only in a few instances are the upper surfaces flaked all over, and the butt-end normally retains large areas of cortex. Retouching had been carefully executed on the tip. Enormous picks also occur but they are rare. Basically, picks are one of the distinguishing features of the Bose industry (see 4, 8 of Figure 2).

Scrapers

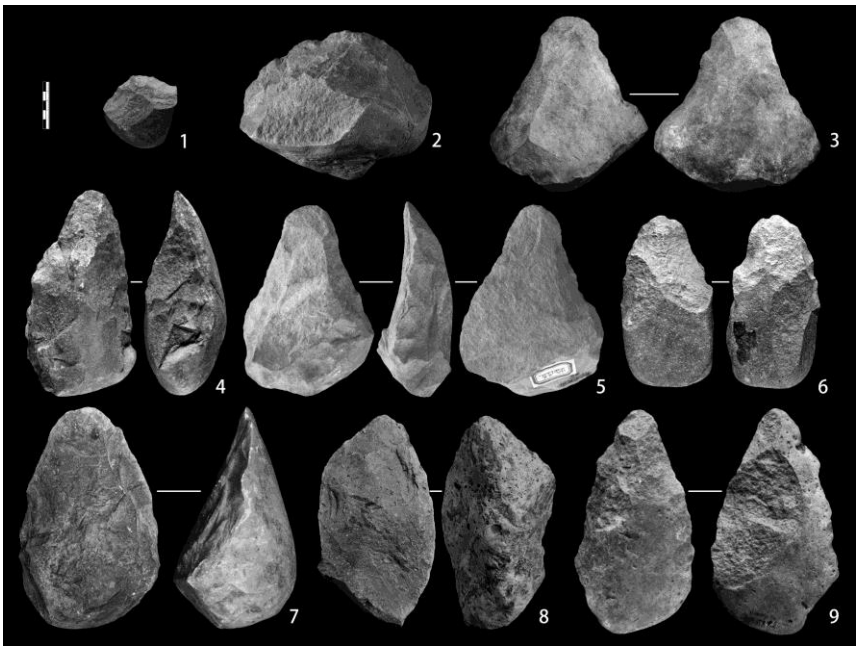
Scrapers comprise the second largest number in the tool assemblage; most of which are rather large and heavy. The majority were fashioned on cobbles, just a few were

made on flakes. Scrapers differ from heavy-duty tools such as choppers and picks, as they are composed of fine-grained sandstone or silicified rock. Those made on cobbles commonly have a flat unflaked base. In many cases, use traces can be observed on the edges. They range in length between 3cm and 10cm. Side scrapers and end scrapers are common (see 1 of Figure 2).

Cleavers

Cleavers are rare; they were made on cobbles as well as flakes. Raw materials are limited to sandstone and quartzite. Those made on cobbles are only flaked on the upper part, producing a transverse edge. The flake-cleavers were made on large flakes where the ventral surface constitutes a single flake scar, and in most cases secondary working is restricted to the butt-end and/or the lateral borders. They are usually U- or V-shaped (see 1 of Figure 4). In fact, cleavers from the Bose Basin are crude and not as typical as those found in the West.

Figure 2: Stone Tools from Bose



Notes: 1. Scraper; 2. Chopper; 3, 5, 6, 9. Handaxes; 4, 8. Picks; 7. Unifacial handaxe (uniface).

Source: Xie, G.M., Lin, Q., Huang, Q.S. (2003), *Bose Palaeolithic Industry*, Beijing: Cultural Relics Press.

3. The An Khe industry

In recent years, a number of Lower Palaeolithic sites have been discovered in the Ba River Basin, in An Khe Town, Gia Lai Province, Vietnam. This is the transitional area between the Pleiku highlands and the coastal plains of Binh Dinh Province in the south central

coastal region of Vietnam. Since the first discovery was made in 2014, archaeological surveys and excavations have been carried out by a joint Vietnamese-Russian programme. As a result, 23 Lower Palaeolithic sites have been discovered and approximately 1,200 stone artefacts and nearly 150 tektites have been recovered. Almost all the sites are concentrated on flat high ground of river terraces about 430 to 450 m above sea level. The excavations of Roc Tung 1 and Go Da sites have yielded not only bifaces, but also tektites in association with stone artefacts including bifaces in situ which indicates they belong to the same age. Using the $^{40}K/^{38}Ar$ method tektites, found in the lithic collection, have been dated to 806 ± 22 and 782 ± 20 ka BP (Derevianko, et al., 2016 and 2018; Nguyen, 2017).

3.1. Geological background

The Palaeolithic sites are located on an elevated hilly plateau, with terrain seriously affected by erosion. The bedrock is comprised of basalt, acidic tuffs, and granite, while overlying sediments are primarily lacustrine and riverine, including alluvial fans. Soft sedimentation accumulated mainly during the final Early and Middle Pleistocene. Before this, bedrock had been exposed to prolonged weathering, resulting in a relatively thick weathered crust. Artefacts were found in situ under similar circumstances. Cultural layers belonged to a single stratigraphic horizon, and all localities revealed similar lithics in terms of technology and typology.

The stratigraphy of Roc Tung and Go Da differ. At Roc Tung and other sites on the left bank of the Ba River, cultural horizons are located within a laterite overlying, and partially included in weathered crust on the granite bedrock. At the Go Da site, the cultural horizon was found directly in the weathered crust and slope wash sediments. No distinct red laterite layers have been found at Go Da (Derevianko et al., 2018).

3.2. Stone artefacts

Stone artefacts recovered from An Khe can be classified into eight main categories: cores and bifaces; picks; spurred tools; carinated end scrapers; side scrapers; choppers and chopping tools; denticulate tools; and notched tools (Derevianko, et al., 2016). Raw materials used in tool making are cobbles, mainly quartz and quartzite, which were taken from the Ba River valley. Most tools were made on cobbles, and rare tools were fashioned on flakes. Apart from handaxes, tools are mostly unifacially flaked and retouched. Cores and tools vary in size and shape, unretouched flakes were occasionally used (Figures 3 and 4).

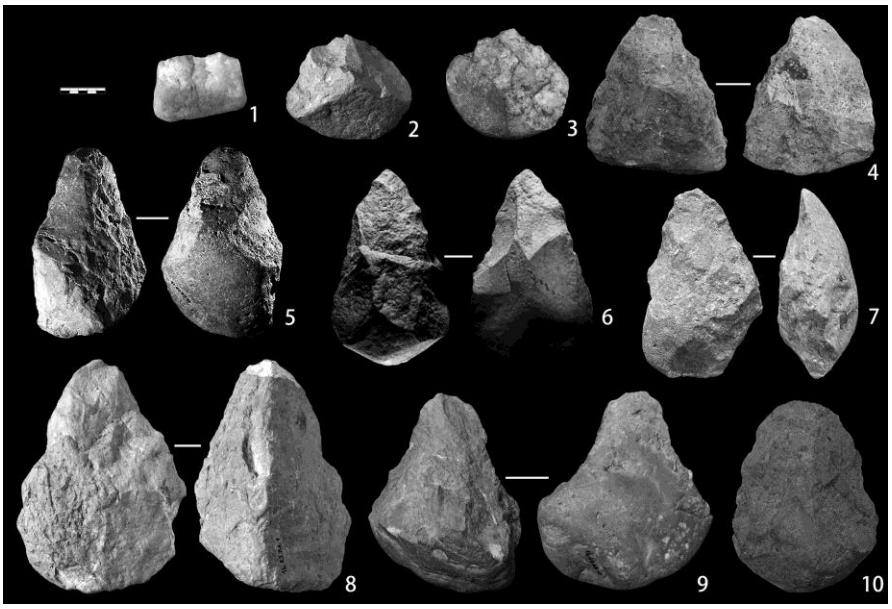
Cores and flakes

While cores and flakes have rarely been found in An Khe, cores can be divided into two types: the dominant ones with a single platform, while the second type has a double-platform. Cortex and single-scar striking platforms have been identified, with the cortex striking platform dominating. Most of the cores have two to three flake scars each. Flakes are mostly primary, those with a length of 10cm to 15cm dominate, while massive flakes (over 20cm) are very rare. Direct hard percussion and anvil techniques had been used to detach flakes, dominated by the former.

Handaxes

Handaxes are especially typical in the tool assemblage and, while not found in abundance, they have been unearthed at nearly all the An Khe Palaeolithic sites. All were manufactured from quartzite pebbles, flaked and retouched bifacially with cortex remaining on the round butt end. The flaked scars are concentrated on two thirds of the body parts, running from the edge to the centre, creating a raised line from the pointed end to the handle. Most of the handaxes are rather large and triangular in outline (see 4, 6, 9 of Figure 3).

Figure 3: Stone Tools from An Khe



Notes: 1. Scraper; 2, 3. Choppers; 4, 5, 6, 9. Handaxes; 7, 8. Picks; 10. Unifacial handaxe (uniface)

Source: 1-9. Photo by Phan Thanh Toan; 10. Nguyen, K.S. (2017), "Early Paleolithic Industry of An Khe and Primitive Period in Vietnam", *Archaeology,* No. 12, pp.13-25.

Picks

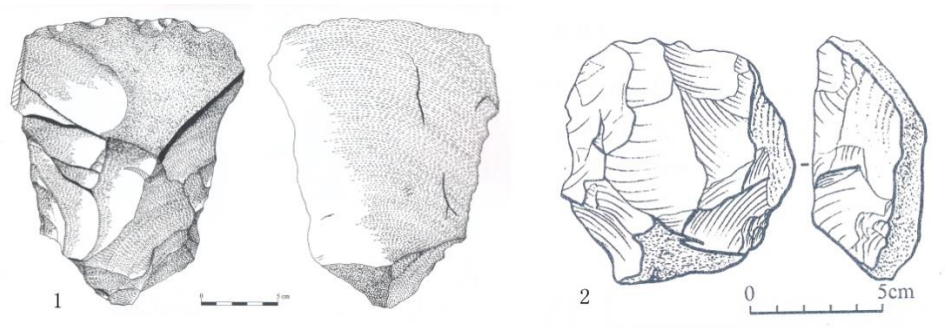
Picks account for a large number of tools found in the assemblage. Most were made on quartzite and quartz cobbles with quartzite dominating. Picks were mainly unifacially worked, only the pointed working edge was exposed to secondary reduction, while the remaining body surface retains the original cortex; the body cross section is triangular. On the whole, these tools are large and heavy, and similar to handaxes in terms of shape and degree of treatment. Unlike bifaces, the pointed ends of these picks are more clearly defined and, in some cases, asymmetrical in form (see 7, 8 of Figure 3).

Choppers and chopping tools

Heavy duty tools are represented by choppers and chopping tools. They were made

on cobbles and, more rarely, chunks of quartzite and quartz. They can be divided into two subtypes: one with a transverse edge and other with a longitudinal edge. Some specimens exhibit a sharpened tip. Other chopping implements show retouching on one surface of the working edge, while others show this on both. Secondary reduction was focused largely on the working edge, whereas other areas retain their cortices (see 2, 3 of Figure 3).

Figure 4: Cleavers



Notes: 1. Bose; 2. An Khe.

Source: 1. Xie, G.M., Lin, Q., Huang, Q.S. (2003), *Bose Palaeolithic Industry*, Beijing: Cultural Relics Press; 2. Nguyen, K.S. (2017), "Early Paleolithic Industry of An Khe and Primitive Period in Vietnam", *Archaeology,* No. 12, pp.13-25.

Scrapers

Scrapers from An Khe can be classified according to longitudinal and transverse working edges. The specimens are further characterised by working edges that are convex, concave, undulating, or serrated. Most of the scrapers were made on flat pebbles, with some made on flakes or pebble fragments. They were mostly unifacially flaked, and in addition to two three row small flake removals, they were additionally treated by retouching. The back area opposite to the working edge always retains its cortex (see 1 of Figure 3).

Spurred and nosed tools

This group differs from bifaces and pick-type tools in that their point was fashioned by additional retouching and small flake removal, which sometimes formed so called "shoulders". In the tool kit, denticulate-notched tools were present. Their working edges were shaped by detaching large flakes on longitudinal and transverse lateral surfaces.

4. Comparisons

4.1. Common characteristics

Both industries belong to the pebble/ cobble industry. Most tools were made on cobbles; tools made on flakes were few in number. Raw materials for tool making are mainly quartzite and quartz. Direct hard percussion was the main method in flaking and

retouching. Most tools were unifacially worked, bifacial working also occurred, especially with handaxes.

Tool types of the An Khe and Bose industries include chopper/chopping tools, picks, handaxes, scrapers, and rare cleavers. In An Khe, the tool categories differ among researchers. Derevianko, et al., (2016 and 2018) classified the stone artefacts into eight main categories: cores and bifaces, picks, spurred tools, carinated end scrapers, side scrapers, choppers and chopping tools, denticulate tools. and notched tools, while Nguyen Khac Su's categories (Nguyen, 2017) include choppers, bifacial tools, handaxes, picks, triangular picks, unifacial tools, knives, cleavers (Figure 4), chopping tools, cores, chopping stone tools with chopped traces, and flakes. In 2015, most of the stone artefacts unearthed at An Khe were housed in the An Khe Museum, and the primary author of this paper studied most of them. According to the categories applied to the Bose industry, the collection of An Khe includes choppers/chopping tools, handaxes, picks, scrapers, cleavers, hammerstones, cores, flakes, and chunks. For example, implements with deliberately fashioned spurs (or a "nose-shaped" point) from An Khe were also found at the Bose site, which have been classified under the handaxe group (bifacially worked) or picks (unifacially worked) (see 3 of Figure 2; 9 of Figure 3).

Handaxes and picks are the most characteristic implements unearthed at both the An Khe and Bose sites. In An Khe, handaxes are Acheulean-like in terms of technology and typology although few in number. They are made of quartzite cobbles and their cortices remain on the rounded butt end which is nearly the same at the Bose site. In addition, unifacially worked handaxes (unifaces), which are a subtype of African handaxes, have also been discovered at An Khe although few in number (see 10 of Figure 3). These handaxes were made unifacially, with flaking and retouching restricted to just the ventral face of the tool, while the dorsal surface was naturally formed shaped like the ventral face. This kind of tool has also been found at the Bose site (see 7 of Figure 2). The tips of An Khe handaxes fall into two types: rounded and pointed, with the former dominating, which is the same as the Bose handaxes.

Picks comprise a high percentage of the tool assemblages of An Khe and Bose, and most were made on cobbles, unifacially flaked with retouching concentrated on the pointed end, cortex remaining on the dorsal surface, and a thick handle. Regarding the An Khe picks, where a cobble had two natural faces forming an obtuse angle, only one more face was made; if the cobble had one flat side, then two more were made (Nguyen, 2017). This is the same in the Bose industry (see 8 of Figure 2). In An Khe, triangular picks are a rather special find in the tool assemblage; they are not only large in size but their backs are also marked by a longitudinal ridge, and therefore the cross sections are triangular. This kind of tool has also been found in Bose (see 8 of Figure 2). In addition, rare massive picks have also been unearthed at both the An Khe and Bose sites. There are two types of picks in An Khe: round (tongue-shape) and pointed, with the former dominating. This is the same with the Bose picks. Other types of tools at An Khe resemble those found at Bose, with similar percentages in the tool assemblages.

4.2. Differences

Apart from the above mentioned common characteristics, differences between An Khe and Bose also exist; the Bose and An Khe basins are geomorphologically different. The former has seven developed terraces and the Palaeolithic sites are mainly situated on T4 and less commonly on T3 and T2. Terraces in the Bose Basin are typically formed of fluvial deposits, in two main parts, with the lower comprising basal gravels and upper part formed of sandy clay loams. In T4, the gravel stratum lies on a Tertiary sandstone bedrock overlain by deposits of Pleistocene sandy clay loams. The Pleistocene deposits can be divided into two units: the lower is primary laterite formed by the action of the Youjiang River while the upper is a secondary deposit produced by slope wash and erosion processes, which lies on the lower discontinuous unit, and the boundary line between them is often uneven, indicating that erosion occurred before the formation of the upper unit deposits. Stone artefacts have been found in both the primary and secondary deposits (Xie, et al., 2018 and 2020). In An Khe, however, the bedrock is composed of basalt, acidic tuffs, and granite, while overlying sediments are primarily lacustrine and riverine, including alluvial fans. Soft sediments were formed mainly during the final Early and Middle Pleistocene periods; before this, the bedrock had been exposed to prolonged weathering, following which a relatively thick weathered crust developed. The stratum containing the main cultural horizon was produced by slope wash and erosion processes (Derevianko, et al., 2018).

At the Bose site, Palaeolithic stone artefacts were discovered not only on different terraces, but also in different stratigraphic layers within the same terrace, especially in T4. Excavations of over 10 sites in the basin between 2005 and 2014 show that handaxes and tektites were found in situ only in the primary laterite of the lower unit deposit of T4, and the Bose industry includes four phases with phase 1 being 803ka and phase 4 as late as 10ka (Xie, et al., 2018 and 2020). In An Khe, however, cultural layers belonged to a single horizon, and all localities yielded similar lithics in terms of technology and typology (Derevianko, et al., 2018).

Raw materials more prevalent at the Bose site show more variation than those of An Khe. At Bose, raw materials used for tool making were quartzite, sandstone, quartz, silicified rock, chert and basalt with quartzite and sandstone dominating. Quartz and silicified rock are common, while chert and basalt were rarely used. In An Khe, however, quartzite and quartz were the main materials with few other rocks identified.

In addition, stone tools retrieved from An Khe are generally larger than those found at Bose although the latter has yielded massive sized ones. Most An Khe handaxes were made on cobbles, but in Bose some were made on flakes, and rare handaxes were flaked all over the body with no cortex remaining. Bose tools show more variation in shape, while subtypes of handaxes and picks are more numerous than those in An Khe.

5. Discussion

5.1. The bifacial industries in southern China (the Lingnan region) and Southeast Asia

The comparison between the industries of An Khe and Bose has identified many

common characteristics. The production of flakes, tool making process. and tool types are pretty similar. The minor differences between them are the raw materials used, tool size, and the time span. Raw materials for tool making varied depending on rock type and availability, for hominins in the Lower Palaeolithic period often selected local stone as raw materials. But different areas may have different rock types, which could have impacted on industries in various regions in terms of technology and typology. However, both the An Khe and Bose sites exhibit similar main tool making materials, although sandstone was also important in Bose. Sandstone and quartzite have similar properties; they are hard, and belong to the middle quality in Clark's (Clark, 1994) category of rock for tool making. In another words, both these materials had a similar influence on tool making technology and typology. The size of tools mainly depended on what raw materials were available at the time. If cobbles were large and the right size for tool making, then the resulting implements were also often large in size, as in the case of the Bose industry. Tools found in the upper reaches of the Youjiang River in the Bose Basin are on the whole bigger than those retrieved from the lower reaches because the cobbles used in making tools were larger than those in the lower reaches. This could have been the same situation in An Khe where tool making cobbles were bigger than their Bose counterparts. As to the chronological differences between these two industries, it can be supposed that different phases of the An Khe industry will be identified through further fieldwork. For example, one phase at Bose was in question until large scale excavation work, carried out at many sites in the basin, resulted in the discovery of Palaeolithic stone artefacts in several stratigraphic layers as well as on different terraces.

Technologically and typologically, bifacial industries in Lingnan and Southeast Asia are very similar. In recent years a new bifacial industry has been discovered in the Nanjiang Basin of Guangdong, southern China. In 2012, the Guangdong Provincial Institute of Cultural Relics and Archaeology conducted an archaeological survey in this basin, and discovered over 60 Palaeolithic sites. In 2014, the institute carried out an excavation at Modaoshan, Yunan County, which unearthed about 400 stone artefacts, including handaxes and picks. In addition, several hundred stone artefacts were collected during the survey in the basin (Liu, 2017). Dating back to the early Middle Pleistocene, this industry is similar to its Bose counterpart.

The Lower Palaeolithic assemblage found at Pacitanian, Indonesia was the first discovery of a bifacial industry in East and Southeast Asia. Bifacial industries were also found in the Philippines, Malaysia (Saidin, 2006; Simanjuntak, et al., 2010; Pawlik, 2002). Based on the form of the tips, handaxes and picks found in Southeast Asia and Lingnan can be divided into two subtypes: pointed end and round or tongue-shaped end with the latter dominating.

Based on the characteristics of heavy-duty tools and the presence or absence of polyhedrons/balls, the bifacial industries in East and Southeast Asia can be divided into two groups or complexes: industries in Southeast Asia including Lingnan, and those in East Asia. In Southeast Asia and Lingnan,

spheroids/subspheroids are pretty much absent and most of the handaxes and picks discovered in these regions have round tips. However, spheroids/subspheroids are common in East Asia. Handaxes and picks, in most cases, exhibit sharp pointed tips. Handaxes and picks had many functions; those with a round tip had a more functional use for digging up tuberous plants. Studies on the use of handaxes found in India indicate that this kind of tool was used for digging (Sankalia, 1978). Picks found in Bose may also have been used for digging up tuberous plants (Wang, 1997) which were probably in plentiful supply in prehistoric Lingnan and Southeast Asia. Polyhedrons/balls of the Lower Palaeolithic period were almost certainly used in the processing of hard fruit nuts (Wymer, 1982). Although spheroids/ subspheroids may have had multi-functional use, including tethered bola stones for hunting, hand-thrown missiles, club heads, bone processing tools, vegetable processing tools, hammers, or even as some sort of symbolic ("non-utilitarian") use (Schick and Toth, 1994), they are thought to have been used to process fruit nuts in China (Wang, 1997), which is a more reasonable explanation of their use in terms of subsistence methods in East and Southeast Asia.

The absence, or rare occurrence, of spheroids/subspheroids in Southeast Asia and Lingnan may have been partly due to the rich availability of cobbles at the site nearby which were ready for use as hammers in processing fruit nuts, and also partly due to hominins inhabiting this region, who largely lived on plants and fruits. Many large and small rivers flowed through this vast region which led to the formation of a great number of cobbles in varied configurations. Hence, it was easy for hominins to find suitable cobbles to use as hammers. Because Southeast Asia and Lingnan are located in tropical and subtropical regions, edible plants, including tubers, must have been in abundant supply like nowadays. And this could have resulted in the different characteristics of the bifacial industries in East and Southeast Asia.

Bifacial industries in Southeast Asia including Lingnan share many common characteristics, and are different in some aspects from those bifacial industries in East Asia. They belong to the same techno-typological complex.

5.2. Bifacial industries in East and Southeast Asia and Acheulean technology

Bifacial industries can differ regionally. Even if they are derived from the same culture, hominins can lose some cultural elements during migration. However, on the other hand, when hominins moved to a new region with a different environment, they had to adapt by using alternative tool kits for subsistence purposes. And such activity led to variations in aspects of stone technology and typology. Furthermore, one particular tool type could have had a number of functions. For example, handaxes in Europe are thought to have been used to slaughter large animals (Clark, 1974), while on the Indian Peninsular they were used for digging (Sankalia, 1978).

It is generally accepted that the Acheulean originated in Africa ca. 1.7 Mya and that with the exodus from Africa, Acheulean technology spread to Eurasia. But Acheulean industries in other regions are more or less different from those in Africa. The Acheulean

spread to Eurasia via the Arabian Peninsula, one of the most important transit hubs. In Arabia the Acheulean was characterised by the presence of bifaces, found together with choppers, and a lack of cleavers. In Europe, the Acheulean industries appeared around 650 to 600ka BP. Although handaxes are common in tool assemblages in Europe, cleavers are rare except in Spain (Beyene, et al., 2013).

In East and Southeast Asia, bifacial industries also differ from those in Africa. In general, bifacial industries in this region are characterised by a low percentage of handaxes and few cleavers. Bose is a case in point where handaxes are rare, accounting for just 6.6% of the stone artefacts. Cleavers are very few in number and not typical (Xie, et al., 2003) and An Khe is the same. However, this is not always the case. For example, in the Luonan sites, handaxes are rather widespread and cleavers are especially common and typical (Wang, et al., 2005; Wang, 2005 and 2006).

Two main factors caused the variation in the bifacial industries of East and Southeast Asia. One was the availability of raw materials for tool making, the other was the physical environment. The technology and typology of an industry can be affected greatly by raw materials. For example, at Zhoukoudian vein quartz was the main material used in tool making, and the bipolar technique was the main tool manufacturing method (Movius, 1948; Zhang, 1987). In the Anyathian industry, handadzes are common because fossil wood was largely employed in tool making (Movius, 1943 and 1948); this kind of material has the structure of wood but is not suitable for fashioning a longitudinal edge. In the bifacial industries of East and Southeast Asia, raw materials of quartzite and sandstone were often used for making tools; the quality of these rocks was poor (Clark, 1994), hence they were used mainly for direct hard percussion and the anvil technique in tool making. In addition, materials were originally in the form of cobbles. Hominins chose cobbles which had a similar shape and size to the planned tool, resulting in cortex remaining on the surface of the tool, especially on the handle. The physical environment was an important factor when it came to characteristics of stone industries, especially in Southeast Asia and Lingnan. Because this region had (and has) a tropical and subtropical climate, animals and plants were abundant, especially bamboo. Just like people today, hominins in the Palaeolithic period must have made full use of the availability of wood and bamboo for tool making. Some researchers have even presumed there was a non-lithic period in Southeast Asia, when hominins only made tools from organic materials (Pope, 1989).

In summary, bifacial industries in East and Southeast Asia were not fundamentally different from the Acheulean one, and in fact they belonged to the Acheulean Complex. Their characteristics resulted from cultural evolution and development as hominins adapted to their new environments in this region.

5.3. Re-evaluating the "Movius Line"

In 1948, Hallam L. Movius in his synthesis, *The Lower Palaeolithic Cultures of Southern and Eastern Asia*, divided the Early Palaeolithic world of Africa, Europe, and

Asia into two monolithic blocks: the "handaxe complex", which included Africa, western Europe, Southwest and southern Asia, and the "chopper/chopping tool complex" which includes East and Southeast Asia (Movius, 1948). According to Movius, hominins in the west (Africa, Europe, Southwest Asia, and India) made handaxes because they were a "progressive" and "dynamic" people, while those in East and Southeast Asia did not make handaxes because they were "conservative" and embodied "cultural retardation" (Movius, 1948).

As mentioned above, handaxes have been found in many parts of East and Southeast Asia. In China, handaxes have been unearthed in many Lower Palaeolithic sites or site groups. In the Republic of Korea, handaxes have also been discovered at many sites, especially those in the Imjin-Hantan River Basins (HRB). In Southeast Asia, in addition to Vietnam, handaxes have been documented in Malaysia, Indonesia, and the Philippines. These bifacial industries date to between the early Middle Pleistocene and early Late Pleistocene. This indicates that handaxes were also common in the region east of the so-called "Movius Line".

Although bifacial industries of East and Southeast Asia differ from each other, they are fundamentally comparable to Acheulean technology. There are arguments that handaxes from East and Southeast Asia are rare, and there is a lack of cleavers (Norton, et al., 2006; Norton and Bae, 2009; Derevianko, et al., 2016); however, this is not the case. At the Fengshudao site in the Bose Basin, handaxes account for 3.2% of the lithic assemblage and 45.5% of the tool assemblage (Wang, et al., 2014). In the Luonan Basin, handaxes and cleavers are not only typical in terms of technology and typology, but also found in high percentages, accounting for 13.9% and 14.2% respectively of the tool assemblage (Wang, et al., 2005). However, handaxes in the West are not always found in large numbers; sites include Markkleeberg, Bilzingsleben, and Schoningen in Germany, Vertesszolos in Hungary, Korelevo in the Ukraine, and various sites in the UK can be attributed to the Clactonian. Even at well-known Acheulean locations, the proportion of handaxes (bifaces) can be low, such as 1.1% in layers 3a, 3b, and 4 at the Singhi Talav site, and 1.4% at the Attirampakkam site regarding layer 6, T3 - both located in India (2/286); or <7%, as at many locations in Ubeidiya, Israel (Dennell, 2016). While cleavers are rare at many sites in East and Southeast Asia, they are also not common throughout the whole Acheulean world. In the Arabian Peninsula, while handaxes have been found at Acheulean localities, there is an absence of cleavers (Derevianko, et al., 2016). In northern France, UK, and Italy, cleavers are also uncommon and even absent at some sites (Santonja and Villa, 2006). Therefore, bifacial industries on both sides of the Movius Line are fundamentally similar; they all belong to the Acheulean Complex.

6. Conclusion

The bifacial industries of An Khe and Bose are important in the study of Lower Palaeolithic cultures of East and Southeast Asia due to their handaxes dating from the early Middle Pleistocene. Comparative studies show that these two bifacial industries are very similar. In fact, technologically and typologically, the bifacial industries in

Southeast Asia and Lingnan share many common characteristics, and also differ from those in East Asia. Therefore, the bifacial industries in East and Southeast Asia can be divided into two subtypes: one which includes those from Southeast Asia and Lingnan, the other from East Asia.

Handaxes, together with picks and cleavers which characterise the Acheulean culture, are widely distributed throughout East and Southeast Asia. The bifacial industries in this region are Acheulean-like and belong to the Acheulean Complex. The Movius Line can never be applied to Palaeolithic archaeological data from East and Southeast Asia, and should be set aside.

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