Palaeolithic and Bifacial Industries of Vietnam in Comparison with Those in East, Southeast, and South Asia

A.P. Derevianko[1], A.V. Kandyba[1], Nguyen Khac Su[2] et al.

[1] Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences.
[2] Institute of Archaeology, Vietnam Academy of Social Sciences.
Email: khacsukc@gmail.com

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Abstract: This study investigates the origin of bifacial lithic industry in the Lower Palaeolithic of Southeast Asia. We describe stone tools from the stratified sites of Go Da and Roc Tung near the town of An Khe, Vietnam. The lithics represent a homogeneous industry, characterised by Lower Palaeolithic primary and secondary reduction techniques. Cores and tools were made using pebbles, and some tools were manufactured on flakes. The tool-kit includes bifaces, picks, spurred implements, carinated end-scrapers, various types of side-scrapers, choppers and chopping tools, and denticulate and notched pieces. Bifaces and picks are the predominant tool types. Primary reduction was aimed at manufacturing simple pebble cores with cortex striking platforms, while radial and orthogonal cores occur less frequently. Tektites found with the lithics were dated by 40K/38Ar-method to 806 ± 22 and 782 ± 20ka BP. We propose to name this industry the An Khe culture. We suggest that the An Khe emerged through convergent evolution of the pebble-flake industry associated with the first wave of *Homo erectus* migration from Africa 1.8-1.6 Ma years ago, and is unrelated to the Acheulean tradition introduced by the second wave of migration to Eurasia.

Keywords: Lower Palaeolithic, An Khe culture, bifaces.

Subject classification: Archaeology

1. Introduction

The Palaeolithic stone tool industries from Southeast Asia (including Vietnam) show great differences in both technology and typology when compared to the coeval industries found in the more western regions of Eurasia. It is believed that the initial peopling of the region seems to have occurred 1.8-1.6 Ma BP, and the first hominin groups who migrated from Africa were *Homo erectus* associated with the

pebble-flake industry rather than Oldowan industry [53]. However, such age estimation relies only on an analysis of fossil remains as no archaeological sites dated to this period and containing stone tools have been found so far. Besides, there are just a few Lower Palaeolithic sites discovered in the region that show reliable stratigraphy. The earliest stratified sites are somewhat older than 1 Ma. In Southeast Asia, some non-contemporaneous Lower Palaeolithic industries are known, including the Tampanian, Anyathian, Pacitanian, and other industries.

Subsequent migrations from western Eurasia that occurred after the initial peopling of the region by *Homo erectus* do not appear to have largely affected the stone tool industries. But it cannot be regarded as an indication that the hominin groups from Southeast Asia lived in isolation throughout this period. Small groups of immigrants could repeatedly enter East and Southeast Asia, leading to gene flow and interactions. However, the stone tool industries from these regions remained largely unaffected and can be considered autochthonous. This stability does not appear to have resulted from cultural stagnation, lack of innovative technologies, or cognitive deficit [29], [30], [8], but rather from environmental plasticity. In particular, the stone tool industries in this region seem to have been adapted to the lack of large sources of high-quality raw materials, leading the Lower Palaeolithic hominins to rely on organic materials such as bone, wood, and especially bamboo [22], [39], [40], [41], [42], [26].

Hallam Movius described two Lower Palaeolithic traditions - the first one, Acheulean, was based on the bifacial technology and distribution in the western part of the Old World (Africa and western Eurasia), and the second one was a pebble technology with choppers and chopping tools (East and Southeast Asia). During the last 70 years, hundreds of Palaeolithic sites have been discovered and analysed in East and Southeast Asia, and the dataset obtained makes it possible to re-evaluate stone tool industries found in eastern Eurasia. The idea of two coexisting culture provinces separated by the Movius Line has been discussed at various conferences and in numerous publications. One of the first discussions was published by Current Anthropology, based on a study by Seonbok Yi and Geoffrey Clark [45]. This initial debate, as many subsequent discussions, mainly aimed at refuting Movius's hypothesis of a cultural boundary. The following study clearly shows that both traditions existed in East and Southeast Asia long time ago and can be regarded as an early appearance of bifacial traditions in this region.

2. The Palaeolithic industries of Vietnam

Madeleine Colani, a French archaeologist, discovered the first Palaeolithic sites in Vietnam. She conducted excavation works in the provinces of Hoa Binh, Ninh Binh, Thanh Hoa, and Quang Binh in the 1920s and early 1930s. These excavations resulted in identification of an Upper Palaeolithic culture named Hoabinhian [47]. Subsequently, caves investigated by Hans D. Kahlke [23], [60] in northern Vietnam yielded stone tools in association with bones of Pleistocene animals and remains of *Homo erectus*. In the 1960s, Pavel Boriskovsky, a renowned

expert in Palaeolithic archaeology, carried out research studies in Vietnam. Not only was he involved in excavation works, but he also trained prospective archaeologists in this country. Eventually, in the 1960s, a Vietnamese school of specialists in Palaeolithic studies emerged.

The earliest Palaeolithic sites showing evidence for the initial peopling of Vietnam are attributed to the initial Middle Pleistocene [49], [50], [60], [6], [31], [9], [1], [43]. Excavations undertaken at the cave sites of Tham Khuyen and Tham Hai, discovered in Lang Son Province bordering China, produced ten teeth of *Homo erectus*, fragments of teeth identified as belonging to extinct anthropoid apes, and remains of primarily extinct fauna species (Ailuropoda, Stegodon, Pongo). These sites are dated to 475 ± 125ka BP [27].

Evidence shows that in Vietnam (as elsewhere in Southeast Asia) local industry was largely based on the use of wood, bamboo, and bone, and demonstrates no significant changes in technological features due to external influence after the emergence of *Homo erectus* in the region. Bamboo seems to have played a particularly important role in early human survival in Vietnam. Bamboo shoots would have been used for food. Ripe bamboo stems could have been used for manufacturing such tools as knives and points. Choppers, chopping tools, side-scrapers, and knives with various modifications were likely employed for processing organic materials. Because of the persistent significance of soft materials in Southeast Asian tools, crude blanks, often described as “Palaeolithic”, actually occur at Neolithic and even Early Bronze Age sites.

In this respect, surface finds collected from Mount Do (Vietnam, Vietnamese: *Núi Đọ*) are to be noted. In 1960, during the excavations of a Bronze Age burial ground and a settlement located in the Thanh Hoa Province, crude stone artifacts were found lying on slopes of Mount Do. Professor Boriskovsky took part in this research project as an advisor. Artifacts recovered from Mount Do drew his attention by their archaic appearance, and he studied this site for several field seasons [49], [50]. Mount Do is situated on the right bank of the Tu River, the tributary of the Ma River, 23km from the seacoast. The mount is composed of Mesozoic basalt with quartz veins. Exposures of basalt bedrock can be recognised at a height of 20-40m above the foot of the mount. Hominins used the basalt scree as a source of raw material for producing stone tools. A total of ~1500 lithic artifacts were collected during the first years of research. 825 of these finds were statistically analysed by Professor Boriskovsky. He identified 782 flakes, including 37 Levallois pieces. Based on his analysis, the artifact assemblage included two typical Acheulean handaxes, one crude bifacial chopping tool, seven crude unifacial choppers, and 15 rectangular handaxes and cleavers including fragments [49, p.60]. Although Professor Boriskovsky had some doubts regarding the exact age of artifacts from Mount Do [49, pp.60-62], he came to a conclusion that the site can be attributed to the Lower Palaeolithic. However, many researchers called into question this attribution [33]. In 1986, Vietnamese archaeologists discovered a Bronze Age workshop on Mount Do. Stone axes showing similarities to Lower Palaeolithic

bifaces appear to have been produced in this workshop [43]. Amazingly, even a highly experienced specialist in Palaeolithic studies like Professor Boriskovsky, was capable in misattributing these late bifacial tools (resembling handaxes in shape and technology) to the Lower Palaeolithic. Typologically similar types of tools were manufactured in South and East Asia for hundreds of millennia and it seems to be the key reason for Professor Boriskovsky's mistake [32, p.354].

Therefore, assessment criteria employed for evaluating African and Eurasian stone tool industries are not always reliable when applied to recognise the Middle Palaeolithic in eastern Eurasia. Evidence shows that stone tool industries from East and Southeast Asia do not appear to have followed cultural sequences observed in Africa or western Eurasia throughout the Pleistocene (more than one million years) without following. No evidence for such an important development as the Levallois technique of primary reduction has been recorded in the region. Meanwhile, dozens of archaeological cultures using pebble, discoid, orthogonal, and other types of cores and a variety a pebble chopping tools have been described in both Vietnam and in eastern Eurasia at large. No valid or generally accepted criteria for distinguishing the Middle Palaeolithic are yet available from this region. The Lower Palaeolithic sites with bifacial tools, such as handaxes, in China cast doubt on the suggestion of one and half million years of stagnation. Bifacial tools appeared in China about 1 million years ago, and were used throughout the Middle and the first half of the Upper Pleistocene. This bifacial industry originated in China and differs from the African and western Eurasian Acheulean, whereas its emergence East Asia may be associated with convergent evolution [12], [52], regardless the fact that tool types in Southeast Asia show no changes in their technological characteristics throughout the Palaeolithic, the discovery in Vietnam of bifacial Lower Palaeolithic tools resembling Acheulean handaxes attests to the absence of cultural "stagnation" in Vietnam.

3. New discoveries of Lower Palaeolithic sites with bifacial industries in Vietnam

Since 2009, the joint Russian-Vietnamese archaeological expedition has been carrying out research works focused on excavating Palaeolithic sites in Vietnam, under the direction of Academician A.P. Derevianko and Professor Nguyen Khac Su. Initially, excavations were conducted in several caves with occupation layers attributed to the Upper Pleistocene.

In central Vietnam, in 2014, Lower Palaeolithic sites containing bifacial tools were discovered near the town of An Khe. Since 2015, these sites were excavated systematically by the joint expedition [44], [54], [56], [57]. During the last four years, researchers identified seven localities where 23 Lower Palaeolithic sites with bifaces were concentrated (Figure 1). 12 sites were found at the locality of Roc Tung situated on the left bank of the Ba River, on the shore of a water reservoir (Figures 2, 3). Roc Lon 1 and Roc Giao 2 were discovered on the same shore. Roc Lon 2 and Roc Nep

1 and 2 are situated east of the Ba River, closer to the mountains. Roc Giao 1 and Roc Huong lie far away from the reservoir, downstream the Ba. The site of Go Da was found downstream of the reservoir, on the right bank of the river, almost opposite Roc Huong (Figure 4). Nui Dat 1, 2 and 3 (Nui = mount, Vietnamese: *Núi*) are also located on the right bank of the Ba, on the gentle eastern slopes of small mount Dat, in close proximity to the local hydroelectric power station.

These sites yielded the Lower Palaeolithic pebble tools recovered from both the modern ground surface and test pits, whereas the finds were found in an undisturbed context.

Systematic excavations at Roc Tung and Go Da were carried out during 2015-2018. The sites located at Roc Tung produced the most technologically and typologically representative assemblages of bifaces. These sites are situated on an elevated hilly plateau cut by numerous rivers, flowing primarily from west to east. The landscape shows evidence for strong transformations due to erosional activity. The bedrock includes basalt, acidic tuffs, and granite, whereas overlying deposits are comprised mainly of lacustrine, riverine, and alluvial fans. Loose sediments appear to have been accumulated mainly during the final Early and Middle Pleistocene. Prior to their deposition, the bedrock had been exposed to prolonged erosional processes, resulting in a relatively thick weathering crust. The upper layer demonstrates signs of heavy disturbance caused by anthropogenic activities (plowing and construction of utility and irrigation structures) reaching 20-30cm depth. Surface artifacts were documented at a depth of about 1m in areas of loose sediments disturbed due to water flows and erosion or by irrigation canals. Other sites in the Roc Tung cluster are dispersed across an area of several square kilometres, and therefore do not represent one site with a single occupation layer. At Roc Tung, trial pits measuring 2m^2 were produced in areas that yielded artifacts and each test excavation revealed artifacts deposited *in situ* in similar contexts.

It is possible to provide only tentative spatial definition of the sites due to their uneven distribution. Further excavations should be undertaken to determine the real number of sites present on the landscape. It is obvious that the area under study is too large to represent only a single occupation of Lower Palaeolithic hominins. Trial excavations revealed that occupation layers are associated with a single stratigraphic unit, whereas lithics recovered from all localities demonstrate technological and typological similarities. Each site in the cluster has a small total area and seems to have been used as a short-term camp in a place that was regularly revisited by ancient humans. This publication describes only sites excavated at Roc Tung and Go Da (for further information regarding all sites, see [58]).

The site of Roc Tung 1 (14°02′253″ N; 108°40′822″ E) was discovered on an elevated and relatively flat area of agricultural land. Surface finds include 52 lithic artifacts, such as cores, pebbles and boulders showing evidence of modification, flakes, choppers, chopping tools, side-scrapers, unifacial point, bifaces, and spurred tools.

Later on, in 2015, excavations measuring 36m^2 at an elevation of 456m above sea level (hereinafter a.s.l.) were carried out.

The southern wall of the excavation revealed the stratigraphic sequence as follows:

The upper part of overlying loose sediments with a thickness of 0.4-0.5m seems to be a dump from an irrigation channel cutting through the undisturbed part of the modern ground surface. These sediments include three layers (Figure 5).

Layer 1. Modern soil buried under the spoil heap, and composed of light loam, gray in colour. The thickness of the unit reaches 0.1-0.2m.

Layer 2. Comprises grayish-brown lightly carbonised loam with a minor admixture of grus (up to 5%). Brownish-red lateritic inclusions occur in some places. The portion of the layer located south of excavation was destroyed by agricultural activities. Thickness: 0.6-0.7m.

Layer 3. Includes brownish-red heavy eluvial loam (laterite). The deposits show a high degree of carbonisation, and progressively change their color to grayish-brown towards the bottom. From the top downwards, lateritic and carbonised sediments gradually mix with weathering crust. Visible thickness up to 0.55m.

The stone tool assemblage obtained from the excavation comprises 70 artifacts, including pebbles showing signs of test knapping (25 specimens), flakes (14 specimens), cores in various stages of reduction (18 specimens), and tools and tool blanks (13 specimens).

Six test pits measuring 2m^2 each were produced at Roc Tung 1. The pit closest to the central excavation was 25m away, and the furthest 120m southwest of the excavation. All the test pits, showing a similar stratigraphic sequence, yielded Lower Palaeolithic artifacts. Test pit 2 contained two cores. One of them was recognised as a single-platform core with one flake removal surface and a cortex striking platform. The other one is a single-platform core with two adjacent flaking surfaces. A chopper-like side-scraper and a spurred tool were also recovered from the pit.

Roc Tung 2 is located 324m northeast of Roc Tung 1 (14°02′253″ N; 108°40′929″ E) at an elevation of 452m a.s.l. Surface finds include 22 pieces. The assemblage comprises a core, pebbles showing evidence of test knapping (4 specimens), large pick-shaped chopping tools and their blanks (11 specimens), and flakes (6 specimens).

The Roc Tung 3 site was situated near Roc Tung 2, 390m northeast of Roc Tung 1. Roc Tung 3 produced three surface finds and three artifacts were found in the test pit, in the stratigraphic context similar to that recorded at other sites.

Roc Tung 4 (14°02′053″ N; 108°40′584″ E) appeared to be one of the most informative sites in the area under study. It is located at 438m a.s.l., precisely 569m southwest of Roc Tung 1. The collection of surface finds includes 56 lithic artifacts: cores (5 specimens), pebbles with traces of test knapping (17 specimens), and large laminar spalls and flakes (34 specimens).

In 2016, a central excavation measuring 2m^2 in area and six test pits (No. 1-6) measuring 2m^2 each have been produced at Roc Tung 4. The stratigraphic sequence in the excavation and test pits revealed the following units:

Layer 1. Modern soil comprising two sublayers.

A. Light loam gray in color with a minor admixture of grus, with a thickness of 0.1-0.2m.

B. Light loam light-grayish-brown in color with a minor admixture of grus (5-7%). Thickness 0.20-0.25m.

Layer 2. The layer consists of heavily carbonised lateritic loam with a high fraction of grus (30-40%) reddish-brown in color. The sediments change their color to grayish-brown toward the bottom. The upper part of the layer comprising boulders and grus contained lithic artifacts. The visible thickness reaches 0.5-0.6m.

The excavation yielded the lithic assemblage consisting of 73 artifacts, including cores (8 specimens), pebbles with traces of test knapping (31 specimens), flakes (30 specimens), and tools and their blanks (4 specimens).

In 2017, field research at Roc Tung 4 has been continued. Archaeological works resulted in producing two excavations and four test pits (No. 7-10) measuring 2m^2 each. Test pit 8 was expanded into excavation 3 [56], while excavation 2 (30m^2) was conducted in the area adjoining the eastern wall of excavation 1, originally studied in 2016.

The stratigraphic sequence in excavation 2 includes the following units:

Layer 1. Includes modern soil. Light loam gray in colour with a minor admixture of grus. The layer demonstrates signs of a heavy disturbance due to modern agricultural activities. The thickness reaches 0.10-0.25m.

Layer 2. Grayish-brown loam with a red tint. It contains a minor admixture of grus (up to 5 %). The sediments are lightly carbonised, and comprise some brownish-red lateritic inclusions. The stratum occurs sporadically. Its major part was possibly destroyed by agricultural activities. The layer is as much as 0.10-0.15m thick.

Layer 3. Consists of brownish-red, highly carbonised lateritic loam. The upper part includes the horizon of boulders and grus, and reveals lithic artifacts. Visible thickness up to 0.4m.

The excavation yielded the artifact assemblage comprising 80 pieces. These are pebbles with traces of test knapping (26 specimens), core preforms (2 specimens), flakes (41 specimens), cores (3 specimens), and tools (8 specimens). Boulders and pebbles of fine-grained siliceous rock were used as raw materials.

Excavation 3 was produced at 440m a.s.l., on a gentle slope, 35 m northeast of excavation 2. Stratigraphic context is the same as in excavation 2. The occupation layer yielded 383 lithic artifacts, including pebbles with evidence of test knapping (101 specimens), core preforms (11 specimens), flakes (206 specimens), cores (30 specimens), tools (32 specimens), and tool blanks (3 specimens). The most common raw material was siliceous rock characterised by dense fine-grained structure, almost without internal defects. Quartzite was much more rarely used.

Roc Tung 5 (14°02′302″ N; 108°40′471″ E) is situated at 443m a.s.l., 632m northwest of Roc Tung 1, on a gentle slope of the eastern coast of a small cove of the water reservoir. A total of 15 surface finds were collected from this site: cores (3 specimens), pebbles with traces of test knapping (3 specimens), flakes (3 specimens), tools (5 specimens), and one tool blank.

Roc Tung 6 (14°01′782″ N; 108°40′927″ E) is located at 448 m a.s.l., 903m southeast of Roc Tung 1, on a hill with slopes smoothed by agricultural activities. At least 1m of the sediments initially present at the site have

been removed through human actions as it may be suggested by remnants of small hillocks, now covered with bushes. Archaeological remains were found on the slope declining towards northeast.

Roc Tung 7 (14°01′421″ N; 108°41′116″ E) is situated at 440m a.s.l., 1,600 m southeast of Roc Tung 1, on one of the small elevations gently sloping eastwards, with a 1.5m deep rice platform. The rest of the slope is heavily deformed by agricultural activities and occupied by cultivated fields [54]. Archaeological evidence was obtained from both ground surface and within sediment deposits.

Excavation measuring 1.20m^2 in area was conducted approximately 30 m north of the hollowed rice field and revealed the following stratigraphic sequence:

Layer 1. Modern soil, light loam gray in colour. The layer shows signs of a heavy disturbance due to modern agricultural activities. The thickness reaches 0.10-0.15m.

Layer 2. Brownish-red, strongly carbonised lateritic loam with a high fraction of grus (up to 30 %). The top part of the layer comprises fine and medium-sized, heavily weathered quartzite pebbles, with archaeological remains. Visible thickness: 0.20-0.25m.

The excavation produced the artifact assemblage that comprises up of 150 pieces, including pebbles with traces of test knapping (52 spec.), core preforms (5 specimens), flakes (63 specimens), cores (11 specimens), and tools (19 specimens).

At Roc Tung sites 8-12, artifacts were collected form the ground surface, whereas test pits revealed similar stratigraphic composition to other sites.

The sites located on the right bank of the Ba River demonstrate a slightly different stratigraphy. The site of Go Da is the best studied site in this locality. It is situated (13°58′306″ N; 108°39′136″ E) 2km from the central bridge across the river, at 440m a.s.l., and approximately 50 m above the water's edge. The excavation works were undertaken 900m west of Ba, on a hill composed of granite bedrock. A part of the site has been destroyed by modern quarrying. A deposit section approximately 41m long remains undisturbed. This east-west oriented section declines in elevation towards the west. The base of the section consists of granite overlain with weathering crust between 20-30cm thick. The weathering crust is covered by slope wash sediments forming an apron. Analysis shows that these sediments are suggestive of significant environment and climate change most probably, a strong cooling event. The slope wash sediments comprise coarse-grained sandy loam, angular grus, and granitic debris. The maximal thickness of the apron is observed in the eastern part of the deposit, the minimal thickness in the western part. In some places, accumulations of coarse debris can be seen; the largest such accumulations are concentrated in the central part of the deposit.

The apron seems to have been formed primarily due to weathering of the granite bedrock and minor transport of coarse debris from the most elevated areas of the ground surface. The formation of the apron was accompanied by erosional processes, rendering its upper portion uneven, while its basal part evenly covers the bedrock and weathering crust. The layer containing the

main cultural horizon was produced by slope wash and erosion processes; herein lies its distinction from the cultural horizons on the left bank of the Ba River.

At Roc Tung and other sites on the left bank of the Ba, occupation layers were recognised within a laterite overlying, and partially included in, the weathering crust on the granite bedrock. At Go Da, the occupation layer was found directly in the weathering crust and slope wash sediments. No distinct red laterite layers (associated with very warm and humid conditions) were present at Go Da. When hominins settled in the An Khe region, the climate conditions would have been cool and arid, prompting the intense deflation and erosion visible in the deposits on the right bank of the Ba River. It is likely that humans still occupied the area when the environment changed: when the climate became warmer and more humid, loose laterite deposits like those at Roc Tung would have begun to form. The difference in ages between these two sites is about 30,000 years.

Occupation layer recognised at the Go Da site was overlain by loose sediments of different origins. These deposits were repeatedly reworked with large time intervals in between deposition events. They include slightly lithified lateritic, slope wash, aeolian, and clay-rich components. Thus, the sedimentation processes occurring on the right bank of the Ba appear to have differed significantly from those that take place on the left bank.

In the Early Pleistocene, the granite bedrock was assumingly exposed for a long time, and a weathering crust seems to have been formed due to deflation. Slope wash apron was formed from weathering crust (5-10cm), large angular grus, and debris during the cooling event at the final stage of the Early Pleistocene. The weathering crust and the lower portion of the apron contained lithic artifacts. Laterite was subsequently formed in sediments overlying the apron; however, because of redeposition and anthropogenic interference, it is impossible to trace this laterite as clearly as at the Lower Palaeolithic sites on the left bank of the Ba River. Nevertheless, an analysis of stratigraphic positioning shows that the Lower Palaeolithic sites on the right bank are somewhat older than those on the left bank.

4. Bifacial industry from Lower Palaeolithic sites in Vietnam

Archaeological research undertaken over four years at the Lower Palaeolithic sites associated with bifaces near the town of An Khe has made it possible to recover approximately 1,200 lithic artifacts, including 872 pieces obtained from occupation layers, and to collect more than 300 surface finds. All finds were attributed to the Lower Palaeolithic and demonstrate a close similarity in terms of typology and techniques of primary and secondary reduction. Bifaces and picks represent the principal types of tools. Such a kind of stone tool industry was discovered in Vietnam for the first time. This industry has been named the An Khe culture.

Lithic artifacts recovered from the Lower Palaeolithic sites in the Ba River basin can be classified into eight main categories: (1) cores and bifaces (implements flaked on both sides) (11 specimens); (2)

picks (56 specimens); (3) spurred tools (40 specimens); (4) carinated end-scrapers (4 specimens); (5) side-scrapers of various types (54 specimens); (6) choppers and chopping tools (70 specimens); (7) denticulate tools; (8) notched tools [55]. Cores and tools were mostly made on pebbles and boulders varying in size and shape, and on their fragments. Rare tools were fashioned on flakes, and unretouched flakes were occasionally utilised. Course-grained vein quartz was the main raw material in the Ba River basin; quartzite was very seldom used. Inhabitants of the sites appear to have collected the raw material in the river valley, where large stones had rolled down in the course of deflation and erosional processes.

Lithic analysis shows that at all the Lower Palaeolithic sites under study primary reduction was focused on producing simple pebble cores, with one or two cortex striking platforms. Stone tool assemblages include a small number of cores with a striking platform made by the removal of one or two flakes, and radial nuclei. Some cores of the first two types demonstrate several flaking faces. Cores with cortex striking platforms in the analysed assemblage include specimens where a flaking surface and striking platform form nearly a right angle (Figures 6, 1). Amorphous flakes of varying size were detached from such cores. In some cases, flaking surface and striking platform are arranged at an acute angle (Figures 6, 2). Removal scars suggest that such cores were used for detaching large flakes with a salient bulb of percussion.

Cores of the second type exhibit a striking platform prepared predominantly by a single removal (Figures 6, 3). Flakes were detached from two conjoining or opposite sides of the core's lateral surface (Figures 6, 4). In very rare cases, cores with two platforms and two flaking faces exhibit initial flaking surfaces that served as the platform for subsequent detachments (Figures 6, 5).

Radial cores occur occasionally in the stone tool assemblage recovered from the sites at issue (Figures 6, 7). These are normally round in shape and demonstrate a lenticular profile and cross-section. Most of them exhibit a striking platform prepared on the edge between the flaking surface and the back of the core. Large flakes were produced by centripetal removals. The preparation of such cores required considerable skill and knowledge of the properties of rocks [55].

Choppers and chopping tools in the assemblage can be subdivided into transverse (Figures 7, 1) and longitudinal (Figures 7, 2) choppers, based on the location of working edges. Some specimens have a pointed tip (Figures 7, 3, 4). Some chopping implements show retouch on one surface of the working edge, others on both. Secondary reduction was focused largely on the blade; whereas other areas retained cortex.

A special category of tools includes pieces with a deliberately fashioned spur (or a "nose-shaped" point) (Figures 7, 5). Distinguishing these from bifaces and picks, the point on this tool type was produced by the detachment of large flakes, or by additional retouching and small spalls forming a kind of shoulder. Some tools in this category are quite large and weigh up to 4kg.

Side-scrapers constitute a rather high proportion of the tool assemblage. The

classification of these implements is based on longitudinal and transverse working edges. The specimens are further characterised by convex (Figures 8, 1), concave, undulating, or serrated (Figures 8, 2) working edge. Most side-scrapers were manufactured on pebbles (Figures 8, 3, 4); some implements were made on large flakes or fragments of pebbles (Figures 8, 5, 6). In contrast to choppers or chopping tools, side-scrapers were produced on flatter pebbles fashioned by two or three rows of large spalls, and subsequently trimmed with fine marginal retouch. Working edges were flaked on one or both sides. In all cases, the back of the tools retains cortex.

The tool kit also includes denticulate (Figures 9, 1, 2) and notched implements. Most of them are smaller than choppers, chopping tools, or side-scrapers. The working edge is fashioned by large spalls removed from the longitudinal or transversal lateral margin. Some specimens demonstrate alternate retouch that forms notches. Similarly to other tools, only the working edge was trimmed, whereas other parts of the implements retain cortex.

Core-shaped scrapers and carinated end-scrapers (Figures 9, 3-5) constitute a small but notable group of tools. These were produced mostly on elongated pebbles. One end of this tool type usually displays scars from small and narrow removals. Core-shaped scrapers are numerous at Lower Palaeolithic sites scattered across a large territory, and comprise a special category of Lower Palaeolithic tools. The earliest core-shaped scrapers were recovered from the pre-Acheulean layers at Olduvai [25]. Carinated end-scrapers were recorded at some Lower Palaeolithic sites associated with pebble-flake and Acheulean industries in Africa, Near East, Caucasus, Siberia (the Karama site), and elsewhere [7], [58], [48], [51]. Their presence at Lower Palaeolithic sites widely separated in time and space seems to have resulted from technological convergence rather than migrations [53].

Bifaces required the most energy expenditure and skill to produce. All implements in the analysed assemblage were made on large, elongate, triangular pebbles with a lenticular profile and cross-section. The convergent tip of such tools demonstrates large flake removals on both sides (Figure 10). In some cases, the working edge was trimmed through the removal of smaller spalls, while the remainder of the tool is covered with cortex. Some artifacts also show evidence of additional working near the “butt” of the biface. A series of symmetric, triangularly elongated bifaces with an unmodified back end contains two specimens that are worth particular mention. One of these was found in excavation 3 of Roc Tung 4 (Figures 10, 4). This biface was fashioned on a large elongated pebble. It has a straight base and slightly curved working edge. In terms of shape, it resembles a shark tooth. One surface of the tool is flat and completely covered with scars from centripetal removals; another surface is convex and almost completely treated with flake removals. Only a small area in the centre retains cortex. Another biface, found in the excavation at Roc Tung 7, displays scars of partial trimming of flat surface by marginal retouch along the entire perimeter (Figures 10, 5).

Pick tools in the assemblage resemble bifaces in both shape and reduction

technique. These were made mostly on large pebbles and boulders, and are normally large and heavy. Only the pointed working edge was subjected to secondary reduction, while the rest of the surface of such implements retains original cortex. The working edge of these tools was bifacially (Figures 11, 1, 3) or unifacially (Figures 11, 2) processed. Regardless of the form of the blank, the section of the working blade was triangular, typical of picks. Unlike bifaces, picks have a distinct sharp-pointed and elongated tip; some tips are asymmetric (Figures 11, 4).

The stone tool industry discovered on the left bank of the Ba was based on the exploitation of local raw material. Quartzite pebbles and boulders were employed for manufacturing cores and tools, and raw material of low quality was commonly used. Effective knapping seems to have been hampered because of heavily cracked and coarse-grained blanks. This conclusion is supported by the recovery of numerous pebbles showing evidence of test knapping and unidentifiable fragments. Blanks were detached from simple cores with a single flaking surface and one or two striking platforms, bearing scars of minimal preparation. Transversally-oriented flake removals show predominance in the assemblage. Heavily exhausted cores are not present; most cores exhibit scars of only one series of primary removals. Radial cores are similarly scarce, and flakes as potential blanks appear to have been of minor importance. Most flakes in the assemblage appear entirely without traces of secondary reduction. This industry, in general, can be classified as a pebble industry, since most tools were fashioned on pebbles; only some small-sized side-scrapers, denticulate and notched tools were manufactured on flakes. Picks, spurred implements, choppers, and chopping tool types predominate in the toolkit, while side-scrapers and notched tools are less frequent. One of the most critical features of this assemblage is the presence of bifacially worked tools that resemble Acheulean bifaces in terms of morphology and technique.

Given the technological traits of this industry and their stratigraphic location, it is undoubtedly Lower Palaeolithic an observation that we confirmed through geochronology. Along with lithic artifacts, we recovered around 200 tektites, melted and firmed glassy bodies formed by meteorite impacts. Two tektite samples from Go Da and Roc Tung 1 were analysed in the Laboratory of Isotope Geochemistry and Geochronology in the Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry, Russian Academy of Sciences (Moscow). The age of 806 ± 22ka BP (lab code 15962) was obtained for the cultural layer at Go Da, while the Roc Tung 1 cultural layer was dated to 782 ± 20ka BP (lab code 15963).

The discovery of a Lower Palaeolithic (final Early Pleistocene) bifacial tradition in Vietnam strongly suggests that Southeast Asia was one of the regions where this industry originated.

5. Lower Palaeolithic bifacial industries in East, Southeast, and South Asia

Hallam Movius defined two zones for the Lower Palaeolithic industries: 1) the western

zone, where bifaces predominated (including Africa and Eurasia west of Central India); 2) and the eastern zone, where choppers and chopping tools appeared most commonly (areas east of Central India). However, at the time his “Movius Line” hypothesis was developed, he was aware of bifaces found in Southeast Asia. Gustav von Koenigswald was the first to report on bifaces found in 1935 at Patjitan, in the southern part of Central Java. Subsequently, bifaces were found in Sumatra, Kalimantan, Bali, and other regions. Movius himself [29], [30] recognised 153 handaxes in the Patjitan industry, where they constituted 6.32% of the tool assemblage. These tools were present in lesser quantities than choppers (17.8%). The industry also included chopping tools (3.68%), hand adzes (3.59%), and proto-handaxes (8.06%), which are typologically closer to handaxes than to choppers or chopping tools [29], [30].

Despite knowing about such bifaces in the Patjitan industry and those found at Tingtsun, China, Movius [31], [32] nonetheless argued that the Palaeolithic of East and Southeast Asia was radically different from that of the rest part of Eurasia. He may have reconciled this discrepancy by two reasons. The first is that Movius attributed the Patjitan industry to the Late Pleistocene. Indeed, the Tingtsun bifaces date to that stage. In Europe, this period corresponded to the post-Acheulean age, when the Mousterian was underway. The second reason may be that at the time when the study of the Palaeolithic in eastern Eurasia had only begun, Movius felt that the stone tool industries of that part of the world and those in the west evolved in different ways.

Although the specific evidence for this division has changed, the totality of archaeological data accumulated over the last six decades supports the east-west division of the Palaeolithic industries proposed by Movius - an idea that is further supported by the discovery of the bifacial industry in Vietnam.

The dispersal of *Homo erectus* associated with the Acheulean from Africa to Eurasia began ca 1.4 Ma BP. The earliest evidence for this movement comes from Ubeidia, Israel - the earliest Acheulean site in Eurasia (Bar-Yosef, Goren-Inbar, 1993). A number of Acheulean sites in Levant, dating to ca. 1 Ma, may indicate continuity in the evolution of hominins in that region [58], although this is only a hypothesis requiring further proof. Data resulted from the thoroughly studied archaeological site of Gesher Benot Ya’akov indicate that the second migration wave of *Homo erectus* with the Acheulean industry from Africa to the Near East occurred during the MIS 20 [15], [18], [16], [17], [19]. What were the consequences of this wave further east?

The important transit areas for populations associated with the Acheulean culture were the Arabian Peninsula and the Iranian Plateau. In Arabia, the Acheulean localities are primarily represented by surface sites [38], [48]. The Arabian Acheulean is characterised by bifaces in tandem with implements made on flakes, choppers, and chopping tools. The vast majority of cores are unidirectional with subparallel flaking; cleavers are mostly absent. The northern Arabian Acheulean, unlike that of southern Arabia, includes a few cleavers. The Levallois reduction technique was seldom if

ever practiced either in the north or in the south of Arabia. The Acheulean appeared in Arabia ca. 500-450ka BP.

A comparative analysis of technological and typological features of the Acheulean in southern Arabia and in the Near East shows that bifaces are among the few common features of those industries. In the Near East, however, bifaces were produced mostly on flakes, whereas in southern Arabia they were made on nodules and large cores. In Arabia, bifaces were prepared by the removal of variously sized flakes that rarely show evidence of retouching. No indications of using the typical Levallois technique of primary reduction were found in southern Arabia. In the Near East, its earliest example comes from Gesher Benot Ya'akov. Eventually, the Levallois technique became predominant at Acheulean sites.

In Iran, approximately 15 Acheulean sites have been discovered. Most of these are concentrated in the country's northwestern reaches, near the Levant and the Caucasus, and in the northeastern area, adjoining Turkmenistan [3], [4], [5]. Acheulean assemblages have been recovered mostly from surface sites, and consist of a few bifaces and cleaver-like implements. These suggest that the Levallois technique was rarely used. The earliest sites can be attributed to the period not earlier than 500-450ka BP.

In Central Asia, the Late Acheulean industry has been identified in Kazakhstan, Turkmenistan, and Mongolia. The most distinct bifacial industry is associated with the final Lower and early Middle Palaeolithic localities [52]. In this vast region, assemblages with bifaces have been discovered from northwestern Kazakhstan (Mangyshlak Peninsula), in the Cis-Baikal, and in the Irtysh River basin. In Kazakhstan, the greatest number of bifacially worked tools has been recovered from the Mugodzhar Hills [52].

Across Central Asia, all Palaeolithic assemblages containing bifacially worked tools are characterised by the Levallois primary reduction technique, and cleavers are not present. Bifacially worked tools, mostly produced on subtriangular pebbles, are few or isolated. Technologically and typologically, these bifacial tools cannot be regarded as a coherent group. All the Palaeolithic localities in Central Asia are not older than 300-50ka years.

It should be noted that the Indian subcontinent is a region where bifacially worked tools emerged very early. About 10 archaeological sites associated with bifaces, dating from 1.2 to 0.6 Ma years old, have been discovered in South Asia. These are Isampur [31], [35]; Attirampakkam [36], [37]; Morgaon (> 780 ka BP); Singhi Talav (> 800 ka BP); and Bori (670 ± 30ka BP) [28], [35], [36], [14]. Assemblages from these sites include bifacially worked tools made on pebbles. The presence of Acheulean cleavers in this region is dubious, and one of the present authors believes that in India, as in East and Southeast Asia, the emergence of bifaces seems to have resulted from convergent technological evolution [52].

The probable migration event associated with the Late Acheulean likely reached India ca. 600-500ka years ago, or possibly somewhat earlier. R. Dennell [10, pp.375]

claimed that bearers of the Acheulean culture appeared in India and Pakistan no earlier than 700-600ka BP. Several hundred Late Acheulean sites spanning the time interval between 500-100ka BP were discovered in India. Based on evidence showing that the Acheulean industry appeared in adjacent areas west of India (Arabia and Iran) no earlier than 700ka BP, it is possible to infer a convergent, independent emergence of the bifacial technique in South Asia (ca. 1 Ma).

In summary, the first migration wave of *Homo erectus* associated with the Acheulean appears to have moved from Africa eastwards ca. 1.4 Ma BP, but had not spread beyond the Near East. The second such wave, originating from Africa at the boundary between the Early and the Middle Pleistocene (Gesher Benot Ya'aqov), marked a rapid advance of the Acheulean into Europe and Asia. This could be either a direct migration or a chain-like transmission of skills involved in the bifacial technology from one hominin group to another.

In Asia, first bifacially worked tools were discovered in China. Excavations undertaken in Pingliang and Yunxian yielded assemblages that contain solitary bifaces and cleavers [46], [21]. About 30 Palaeolithic sites with stone tools recognised as handaxes and cleavers attributable to the Lower, Middle, and Upper Pleistocene have been identified at theses localities. Bifaces were most numerous in the Guangxi Zhuang Autonomous Region, in the Baise Basin, bordering Vietnam. Based on 40Ar/39Ar dates on tektites from Baise localities, these sites containing bifaces have been dated to ca. 732 ± 39 and 803 ± 3ka BP [20]. The biface-bearing layer comprised tools with working edge flaked on both faces, including chopping tools with signs of reduction extending to a greater or lesser surface, resembling the earliest bifaces of Africa [61], [62].

The emergence in China of bifaces similar to Acheulean ones resulted from convergent evolution that appear to have occurred on a local basis. No other implements found in association with bifaces share common characteristics with the Acheulean industry, and no handaxes of such antiquity have been found west of China. The Baise handaxes are a striking example of convergence in the Lower Palaeolithic. Moreover, although bifaces appeared in China at various stages of the Stone Age, these show no technological or typological continuity with the Baise handaxes. This pattern suggests that convergent cultural evolution led to the appearance of bifaces at later stages, when the adaptation strategies had changed. For instance, bifacially worked tools from Dingcun differ from Baise handaxes both typologically and technologically, and they are 500-600ka years "younger" than Baise specimens.

The Baise industry shows a close similarity to the industry of the An Khe culture in central Vietnam, and differs significantly from the African and European Acheulean. Localities associated with bifaces in southern China and Vietnam are also much older than Acheulean sites in transit areas between Africa (Turkmenistan, Mongolia, and Kazakhstan) and East and Southeast Asia. These industries are also quite dissimilar in terms of both technology and typology.

Ages obtained on tektites from sites containing bifaces at Baise were called into

question by some researchers [24]. Critics suggested that most tektites had been redeposited. Moreover, based on ethnological evidence, these tektites were regularly used by natives of Southeast Asia for making stone tools or as amulets. The discovery of tektites *in situ* at Lower Palaeolithic sites near An Khe would seem to render these objections moot. All tektites at the localities under study were found in association with stone artifacts in the lower stratigraphic layer, within lateritic sediments containing products of bedrock erosion, or within the weathering crust. The lower layer at the places where tektites occurred demonstrates no indications of anthropogenic or natural disturbances. Tektites are very small, so it is hardly possible to manufacture artifacts on them. In our view, there are no justifiable reasons to challenge the synchronicity of tektites and bifaces at the Lower Palaeolithic sites in north-central Vietnam.

On the basis of the argon analysis, as mentioned above, sites with bifaces near An Khe date to 806 ± 22ka BP and 782 ± 20ka BP [57]. Technologically and typologically they are similar to those identified at Baise. In our opinion, both result from convergent evolution.

Sometimes it is difficult to recognise bifaces, picks, or chopping tools among other Lower Paleolithic implements found in the An Khe region for they share many features in terms of morphology, technique, and extent of secondary reduction. All these tools seem to have had similar functions. Apparently, producing implements suitable for cutting and processing bamboo, crushing, scraping was of great importance. The type of blank, as well as primary and secondary reduction, determined the shape of the implement. No bifaces flaked over the entire surface have been found in the An Khe region. Artifacts of subtriangular shape with one third or a half of surface flaked on both sides, and a deliberately prepared pointed tip were found to be the most common.

It should be kept in mind that these tools from Vietnam, when described as bifaces (handaxes), are not identical to the African or European Acheulean bifaces (Figure 12).

6. Conclusion

A hypothesis that the bifacial technique was introduced to Eastern Eurasia by migrants of the second wave is based on the fact that Acheulean sites dating to 700-800ka BP were not found anywhere from the Near East to Vietnam and China. The presence of bifacially flaked tools appears to be the only feature linking the bifacial industries of Vietnam with the Acheulean culture. However, our research shows that the bifaces of the An Khe industry are very different from those of the European Acheulean, as well as from other artifacts of that industry. It may reasonably be assumed from the absence of cleavers or the Levallois technique at An Khe sites that the bifacial technique emerged in Vietnam and China due to convergent evolution. We argue that in East and Southeast Asia this technique evolved from the local pebble-flake tradition, as indicated by primary knapping, secondary reduction, and the entire technological and typological complex of the Lower Palaeolithic.

ILLUSTRATIONS

Figure 1: Map Showing the Location of the An Khe Lower Palaeolithic Sites

Source: Derevianko A.P., A.V. Kandyba, Nguyen Khac Su, S.A. Gladyshev, Nguyen Gia Doi, V.A. Lebedev, A.M. Chekha, A.G. Rybalko, V.M.Kharevic and A.A.Tsybankov (2018), "The Discovery of a Bifacial Industry in Vietnam", *Archaeology, Ethnology & Anthropology of Eurasia*, Vol. 46, No. 3.

Figure 2: Roc Tung 1-5 Lower Palaeolithic Sites

Source: See Figure 1.

Figure 3: Roc Tung 6-8, 10, and 11 Lower Palaeolithic Sites

Source: See Figure 1.

Figure 4: Go Da and Roc Huong Lower Palaeolithic Sites

Source: See Figure 1.

Figure 5: Stratigraphy of Roc Tung 1

Source: See Figure 1.

Figure 6: Stratigraphy of Go Da

Source: A.V. Kandyba.

Figure 7: Cores from the Sites of the An Khe Lower Palaeolithic Culture

Source: See Figure 1.

1, 2- with a single flaking surface and single cortex striking platform;

3- with a single flaking surface and single prepared striking platform;

4- with two flaking surfaces and single cortex striking platform;

5- with two flaking surfaces and two striking platforms;

6, 7- radial;

1- Roc Tung 10;

2, 5, 7- Roc Tung 4;

3, 6- Roc Tung 1;

4- Roc Tung 7.

Figure 8: Tools from the Sites of the An Khe Lower Palaeolithic Culture

Source: See Figure 1.

1- chopper with a transverse working edge;

2- chopper with a longitudinal working edge;

3, 4- choppers with a sharpened tip;

5- spurred tool;

1, 2, 4- Roc Tung 4;

3- Roc Tung 1;

5- Roc Tung 7

Figure 9: Side-scrapers from the Sites of the An Khe Lower Palaeolithic Culture

Source: See Figure 1.

1- side-scraper with a convex working edge;

2- side-scraper with an undulated working edge;

3, 4- side-scrapers on pebbles;

5, 6- side-scrapers on flakes:

1, 2, 5, 6- Roc Tung 4;

3- Roc Tung 1;

4- Roc Tung 7

Figure 10: Tools from the Sites of the An Khe Lower Palaeolithic Culture

Source: See Figure 1.

1, 2- denticulate tools; 3-5- core-shaped scrapers; 1- Roc Tung 4; 2-5- Roc Tung 1

Figure 11: Bifacially Worked Tools from the Sites of the An Khe Lower Palaeolithic Culture

Source: See Figure 1.

1- Roc Giao 1; 2- Roc Lon 2; 3- Roc Tung 10; 4- Roc Tung 4 (excavation 3); 5- Roc Tung 7 (excavation 1)

Figure 12: Bifacial Tool of the An Khe Culture

Source: See Figure 1.

1, 3- with bifacially flaked working edge; 2- with unifacially flaked working edge; 4- with asymmetric working edge; 1-3- Roc Tung 4; 4- Roc Tung 1

Notes

[1, 2] The co-authors are S.A. Gladyshev, A.M. Chekha, A.G. Rybalko and V.M. Kharevich from Institute of Archaeology and Ethnography; Nguyen Gia Doi from Institute of Archaeology, Vietnam Academy of Social Sciences; and V.A. Lebedev from Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry, Russian Academy of Sciences. This study was supported by the Russian Foundation for Basic Research (RFBR), (Project No. 18-59-92001 *BAOH_a*).

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