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Middle Pleistocene handaxes from the Korean Peninsula

Christopher J. Norton [a,*], Kidong Bae [b], John W.K. Harris [c], Hanyong Lee [b]

[a] Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, 142 Xizhimenwai Street, Beijing 100044, China
[b] Department of Anthropology, Hanyang University, Ansan, Kyunggi-do 425-791, South Korea
[c] Department of Anthropology, Rutgers University, 131 George Street, New Brunswick, NJ 08901, USA

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Abstract

We present four biface assemblages from an archaeologically poorly known region of the Old World: Middle Pleistocene Korea. The handaxes are derived from a series of Middle Pleistocene localities in the Imjin/Hantan River Basins (IHRB) in Korea. The best known of these localities is Chongokni, although a number of equally important sites in the IHRB have been discovered and excavated over the course of the past two decades (e.g., Kumpari, Chuwoli, and Kawoli). Reanalysis of the age of the Chongokni deposits suggests a hominin occupation between 350–300 ka. Comparative study of the IHRB handaxes with the well-known bifacial implements from Olorgesailie (Kenya) and Hunsgi-Baichbal (India) indicates that the often-noted "thick" trait of the East Asian handaxes differs at a statistical level across the various regions of the Old World. The finds from the IHRB sites, and the Chinese sites of Bose and Dingcun that contain handaxes-like implement, question the validity of the Movius Line *sensu stricto*. However, why East Asian Middle Pleistocene hominins did not consistently produce more refined bifaces across broader regional and/or temporal facies, remains open to question. Thus, the absence of similar sites in wider areas of Early and Middle Pleistocene East Asia suggests that the Movius Line *sensu lato* is still supportable and warrants additional detailed cross comparative studies of the stone toolkits east and west of the line.

Keywords: Korea; Imjin/Hantan River Basins (IHRB); Early Paleolithic; Movius Line

Introduction

The ability to produce bifacially worked stone tools is often viewed by paleoanthropologists as a major cognitive breakthrough. Once it became evident that handaxes, cleavers, and picks (i.e., Acheulean tool complex or Mode II technology) postdated the earliest core and flake industries (i.e., Oldowan tool complex or Mode I technology), paleoanthropologists associated the production of these more refined heavy-duty tools with more advanced hominin behavioral and cultural patterning such as enhanced planning aptitude, learning ability, technical competence, long range mobility strategies, and possibly symbolic thought. This correlation is based on the justifiable assertion that Mode II stone tools display a degree of standardization not evident in Mode I technology (Gowlett, 1986). We now know that the Acheulean stone toolkit initially appeared in Africa by about 1.5 Ma (Asfaw et al., 1992) and spread to other regions of the Old World, although the Oldowan core and flake tool complex continued to appear into historic times (Kleindienst, 1961; Roe, 1964, 1968, 1981, 1994; Leakey, 1971; Isaac, 1977, 1984; Toth and Schick, 1986; Potts, 1988; Wynn and Tierson, 1990; Schick and Toth, 1993, 2001; Gowlett and Crompton, 1994; Wynn, 1995; Foley and Lahr, 1997; Klein, 1999; McPherron, 2000; Villa, 2001; Noll and Petraglia, 2003).

One of the most interesting questions in Paleolithic studies is related to the regional variation in the presence/absence of the more technologically advanced Mode II tool complex of the Pleistocene Old World, particularly East Asia. The root of the query is that in many regions of the western Old World,

* Corresponding author.
E-mail addresses: cjn@ivpp.ac.cn, k_s_g@hotmail.com (C.J. Norton).

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handaxe-bearing assemblages appear to have phased out the original Oldowan core and flake toolkits, whereas in the eastern Old World there appears to have been continuous production and utilization of Mode I implements. This dichotomy is known as the "Movius Line," after the Harvard archaeologist Hallam Movius who first noted the distinction between Acheulean industries in the western Old World and the apparent absence of refined bifaces east of the Indian subcontinent (Movius Line *sensu stricto*; Movius, 1944, 1948, 1969). Since Movius' observations, there has been ongoing dialogue in the paleoanthropological literature regarding this behavioral dichotomy (e.g., Luchterhand, 1978; Aigner, 1981; Yi and Clark, 1983; Pope, 1989; Schick and Dong, 1993; Clark, 1994; Pope and Keates, 1994; Schick, 1994; Larick and Ciochon, 1996; Petraglia, 1998; Leng and Shannon, 2000; Hou et al., 2000; Keates, 2000, 2002; Corvinus, 2004).

We present a series of biface assemblages from Middle Pleistocene deposits of the Korean Peninsula and compare these with those from India and Africa. The handaxes that form the foundation of this study were discovered over the past quarter century from a series of open-air Early Paleolithic localities in the Imjin/Hantan River Basins (IHRB) in Korea (Chongokni, Kumpari, Chuwoli, and Kawoli; Fig. 1). Furthermore, two localities in China (Dingcun, Bose) are considered in which handaxe-like implements have been discovered both *in situ* and as surface finds. The IHRB handaxe assemblages are then compared to the better-known biface collections from Olorgesailie (Kenya) and Hunsgi-Baichbal (India) to explore inter-regional variation east and west of the Movius Line. In this paper, we utilize the two stage cultural model ("Early" and "Late" Paleolithic) proposed by Gao and Norton (2002) because the three stage Paleolithic sequence ("Lower," "Middle," "Upper") normally applied in Old World prehistoric research is not applicable in East Asia, particularly China and Korea.

Imjin/Hantan River Basins (IHRB) sites

Early Paleolithic handaxes were discovered in the IHRB region in the spring of 1978 just outside the town of Chongokni (see Fig. 1). Chongokni is situated on a basalt plateau with mountains to the east and low hills and flat plains to the west. The present day Hantan River flows between the basalt plateau and the low-lying mountains, although it is assumed that the path of the river fluctuated throughout much of the Pleistocene. Surveys and excavations were conducted at Chongokni beginning in March 1979 under the direction of Professor Wonyong Kim, then Director of the Seoul National

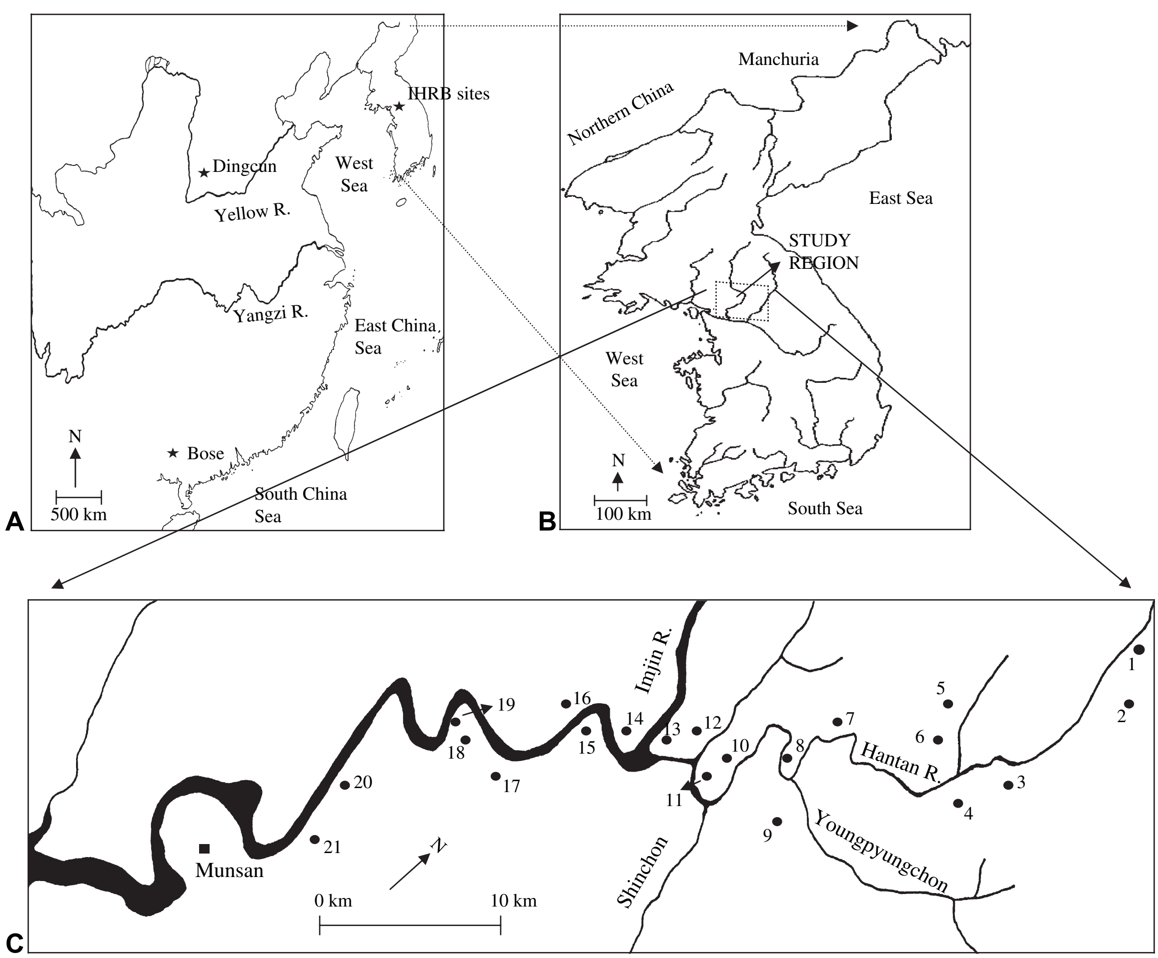

Fig. 1. A) Locations of major handaxe localities in East Asia. B) Study area of the IHRB region in Korea. C) Microregional breakdown of IHRB (#10, 11: Chongokni; #18: Kawoli; #19: Chuwoli; #21: Kumpari; Fig. 1C after Yoo, 1997).

Fig. 2. Artifact horizon (level E94N65-I) from the 1994–1995 Chongokni field season.

University Museum, and researchers from other archaeological institutes. Since the initial discovery of hominin occupation at Chongokni, the area has been surface surveyed and excavated 11 times, resulting in the discovery of over 5,000 heavy-duty tools, flake implements, and debitage. In particular, the 1994–1995 field excavation revealed a high concentration of *in situ* artifacts and debitage (Fig. 2; Yi, 1989; Norton, 2000; Bae, 2002).

As a result of surveys and test excavations in other zones of the IHRB, a number of additional Paleolithic sites have been discovered (see Fig. 1). The best known and published of these are Kumpari, Kawoli, and Chuwoli. Two separate localities were discovered just outside the village of Kumpari in 1989 during archaeological surveying by the Department of Archaeology, National Research Institute of Cultural Properties (NRICP). Kumpari is located along the lower end of the Imjin River, only a short drive from Chongokni. Between 1989 and 1992, four excavations were carried out by the NRICP under the direction of Kidong Bae. As a result of the fieldwork, almost 3,000 artifacts produced primarily of quartz and quartzite were recovered from two localities. Ten oval depressions with heavy concentrations of artifacts were discovered at Kumpari (Fig. 3). The depressions are irregularly shaped, and it is not clear how they were formed. However, it has been suggested

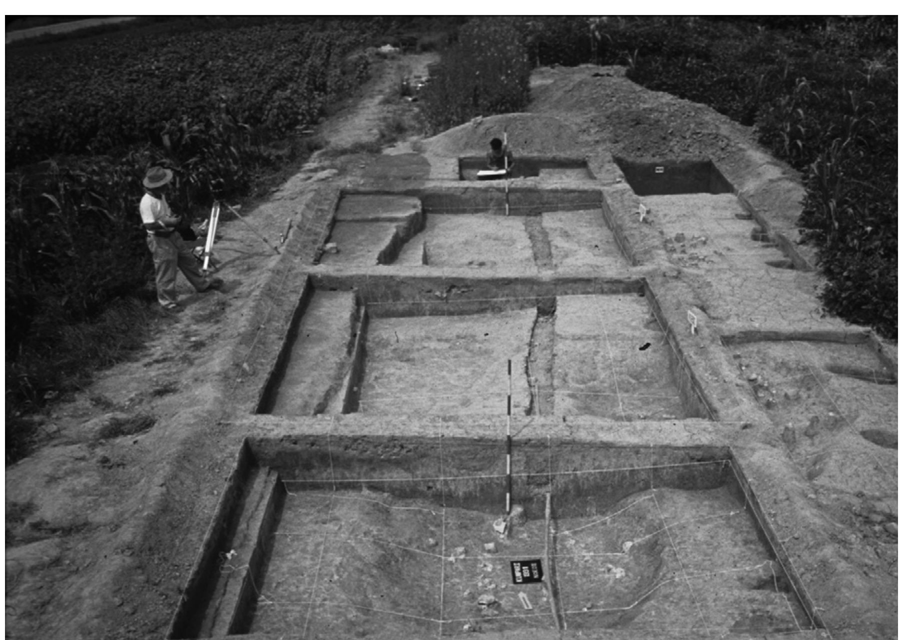

Fig. 3. Example of oval depression from Kumpari (in closest test pit). Note the higher density of lithics in the depression as opposed to the outer area.

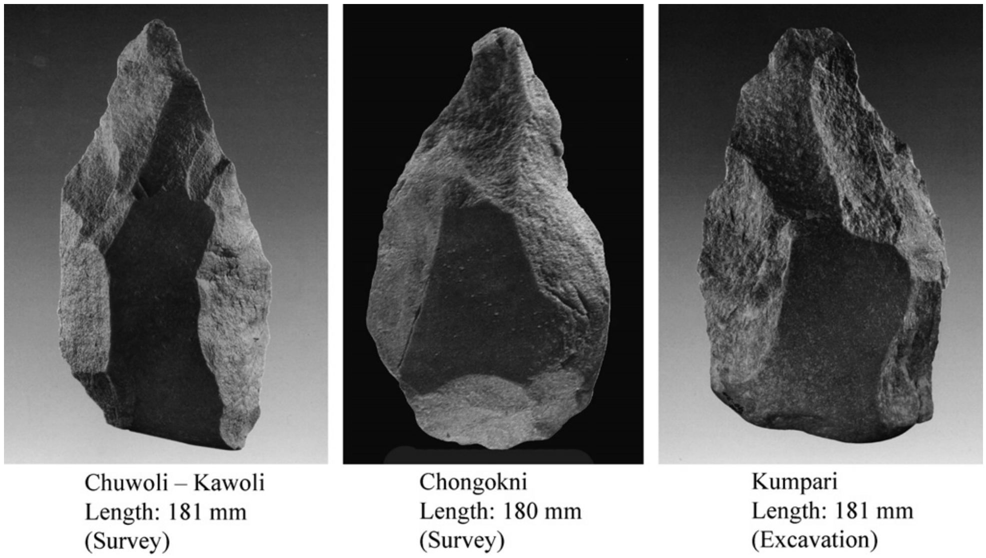

Fig. 4. Handaxes from the major localities in the IHRB, Korea.

that these sites may represent areas utilized for repeated stone-knapping (Bae, 1992, 1998, 2002; Bae et al., 1999).

Paleolithic artifacts were discovered in Chuwoli and Kawoli in the spring of 1988. Additional surface survey and small-scale excavation of the two localities in 1993 led to the discovery of some 600 lithic artifacts, many produced on quartz and quartzite, with a smaller percentage on olivine basalt. Most of the stone tools were flakes and debitage, while a few handaxes and cleavers were also discovered during the fieldwork (Yi and Lee, 1993; Yi, 1996). In 2005, approximately 200 more lithics were discovered during renewed excavation work at Kawoli by Hanyang University.

Except for the low percentage (≤5%) of handaxes, picks, and cleavers in the IHRB lithic assemblages, there are no distinctive differences between the Korean Early Paleolithic collections and many of the coeval northern Chinese collections (e.g., Zhoukoudian Locality 1) that are represented primarily by cores, small flake tools, and debitage (Figs. 4–7). Hominins manufactured the IHRB stone tools by direct hard-hammer percussion. The majority of the heavy-duty and flake tools lack secondary modification (e.g., retouching), and are considered expedient and casual in nature. The primary raw materials utilized at the IHRB sites are local vein quartz and quartzite river cobbles. Unlike many of the Middle–Late Pleistocene Chinese lithic assemblages, the IHRB toolkits do not contain stone spheroids, although many polyhedrals exist. Being produced on river cobbles and thick in nature, the IHRB stone toolkits have often been noted for their resemblance to the African Sangoan, albeit not quite as advanced in their manufacture (Yi, 1989; Yi and Lee, 1993; Clark, 1994; Bae et al., 1995; Bae et al., 1999; Norton, 2000; Bae, 2000, 2002). Bae (1994) has suggested that East Asian Early Paleolithic accumulations that have a small percentage of bifaces should be referred to as "Chongoknian." Overall, these assemblages should still be considered a variation of Mode I technology since the stone toolkits are dominated by core and flake tools.

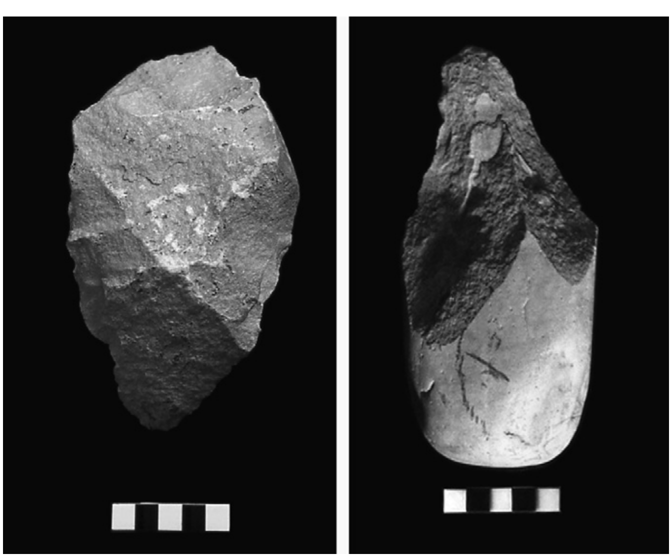

Fig. 5. Examples of heavy-duty tools from Chongokni, recovered during the 1995–1996 field season (survey).

Geology and age of the IHRB handaxes

The Imjin/Hantan River Basins are located in the southwestern region of the Chugaryong Rift Valley, which runs from Seoul in the west to Wonsan on the east coast. The Chugaryong Rift Valley developed through tectonic activity during three primary stages and effectively divides the Korean Peninsula (Table 1). The first stage of rift formation occurred during the Precambrian and is composed of Yonchon and Kyounggy gneiss. This phase represents the base of the Chugaryong Rift Valley. The second stage developed during the Jurassic and Cretaceous and is represented by the Tongjai and Jantanni Basalt strata. The most recent phase is the crystallization of the Baekyuri gravel layer and the Chongok Basalt level, both thought to have formed during the Pleistocene. On the basis

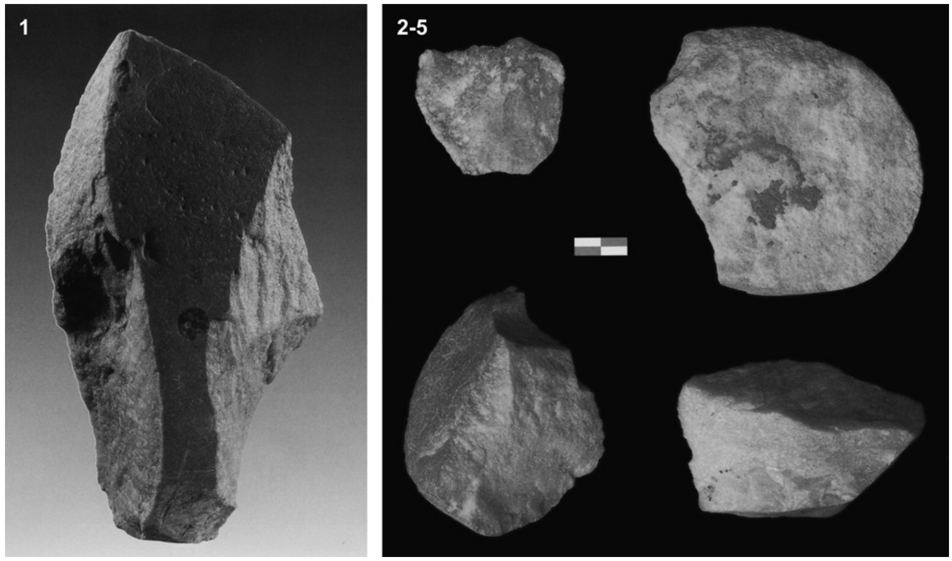

Fig. 6. Typical stone artifacts from Kumpari (excavated). 1) cleaver (length: 158 mm); 2–5) flakes.

of field observation and chemical analysis, at least two basalt flows (and possibly as many as six) have been identified within the Chongok Basalt layer in the IHRB with chronometric dates indicating a Middle Pleistocene age (ca. 0.5 Ma: derived through K/Ar and fissiontrack methods). More detailed geological studies of the basalt are difficult because the majority of the IHRB is situated in the currently inaccessible demilitarized zone separating North and South Korea. The Chongok Basalt stratum, where the Early Paleolithic stone toolkits have been discovered, forms a horizontal basalt plateau that covers the Baekyuri gravel layer. The sediment that overlies the Chongok Basalt has been eroded by natural geological processes as well as by recent cultural disturbance, which have facilitated the discovery of Pleistocene materials through surface surveys and excavation (Fig. 8; Bae, 1989; Yi, 1989, 1996; Bae et al., 1999; Danhara et al., 2002).

Since the initial discovery of the IHRB assemblages, chronometric dates derived from the various layers of the Chongok Basalt have resulted in a wide range of dates (Table 2; [Yi, 1996; Bae, 1997, 2002, 2003; Yi et al., 1998]). A recent analysis focused on the longest stratigraphic profile of the sediment on the basalt bedrock that is situated in the southern area of the

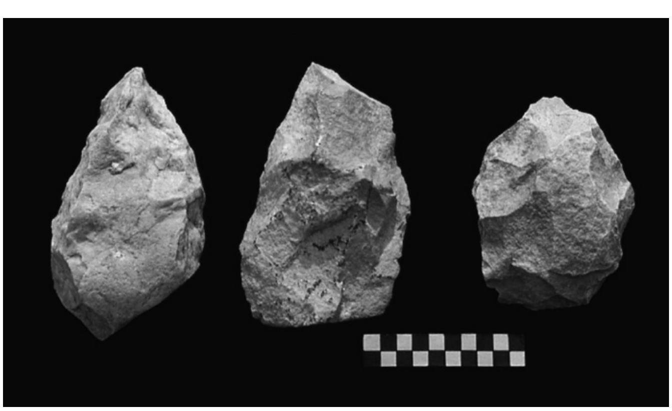

Fig. 7. Typical artifacts from Kumpari (survey).

Chongokni site (E55S20). This profile can be divided into 11 separate stratigraphic layers (level I: top layer, most recent; level XI: base of Chongok Basalt, oldest), with artifacts found as low as level IX (Fig. 9). AT (Aira-Tanzawa) tephra (25–22 ka) was discovered in level II, and K-Tz (Kikai-Tozurahara) tephra (95–90 ka) was identified in level IV. These tephras originated from a volcano in Kyushu, Japan, and their appearance in Korea and the Shandong Peninsula in northern China are the result of two major volcanic eruptions that occurred during the Late Pleistocene (Machida, 1999). Utilizing fission track and potassium-argon dating methods, Danhara et al. (2002) determined that the base of the Chongok Basalt has an age of 500 ka. The lowest levels are thought to be the result of stream channel or lacustrine sedimentation, and Danhara postulated that those levels (X–XI) had a higher rate of sedimentation (see Fig. 9). However, since some of the artifacts, including handaxes, from Chongokni are derived from level IX, assuming a steady sedimentation rate for levels I–IX, it has been estimated that the lowest artifact-bearing level should date to between 350–300 ka (Danhara et al., 2002). Even though Danhara's analysis concentrated on determining the age of the lowest artifact-bearing level of the excavation pit from Chongokni, due to similarities in depositional histories, it appears that a chronometric age range for the other IHRB sites comparable to that at Chongokni is very plausible (see Yi, 1989, 1996; Bae, 1989, 1997, 2002, 2003; Yi et al., 1998; Danhara et al., 2002 for detailed discussion involving the chronometric age of Chongokni and other localities in the IHRB).

Bifaces east and west of the Movius Line

Over the course of the past half-century, several East Asian paleoanthropological localities have been discovered that do not conform to the patterns associated with the "Movius Line." These sites have exposed evidence of technologically advanced heavy-duty stone implements (i.e., handaxes, picks, and cleavers) east of the line. The three best known localities

Table 1
Geological strata of the Imjin/Hantan River Basins. Dates obtained by the potassium/argon (K/Ar) and fission track methods (from Bae, 1989; Yi, 1989)

Stage	Formation	Age	Geological composition	Rock and mineral components
1a	Yonchon	Proterozoic Eon (600 Ma)	granite gneiss	quartz, feldspar, mica schist, amphibolite, chrolite
1b	Kyounggy gneiss	Late Paleozoic Era/Triassic Period	granite gneiss	quartz, feldspar, mica schist, amphibolite, chrolite
2a	Tongjai Basalt (or Tonghyun Basalt)	Middle/Late Jurassic Period (165 Ma)	shale, sandstone, gneiss, granite gravels	quartz, feldspar
2b	Jantanni Basalt	Late Cretaceous Period (52 ± 2 Ma)	shale, sandstone, gneiss, granite gravels	quartz, feldspar
3a	Baekuyri Formation	Pleistocene Epoch	quartzite, gneiss, granite, basalt gravel	quartz, feldspar, biotite
3b	Chongok Basalt	Pleistocene Epoch (500–200 ka)	basalt lava	feldspar, alkali olivine, Ti-augite, pyroxene, magnetite

are the Chinese sites of Dingcun in the north (Movius, 1956; Pei et al., 1958; Qiu, 1985), Bose in the south (Huang, 1987, 1989; Hou et al., 2000), and as discussed above, the Korean sites located along the Imjin/Hantan River Basins.

Dingcun was the first of these biface-bearing sites identified east of the Movius Line. Located in Shanxi Province in northern China, Dingcun was discovered in the spring of 1953 by local workers digging for sand along the Fen River. Dingcun is a series of sites (14 to date) found scattered along a 15 km stretch of the Fen River where archaic *Homo sapiens* fossils, other Pleistocene animal remains, and stone tools have been discovered both as in situ finds and as surface collections. Due to similar depositional histories, the Dingcun localities are often discussed as one site. Based on an array of uranium-series, electron-spin-resonance dating, lithostratigraphic, and biostratigraphic studies, the age range of the Dingcun localities is between 210–75 ka, although most of the chronometric dates appear to fall around the Middle–Late Pleistocene transitional period. Since Dingcun is actually a series of localities and not a single site-complex, it is difficult to obtain a narrower chronometric age range. During the initial excavations, three deciduous hominin teeth and a partial subadult parietal bone were discovered at Locality 54:100; these remains represent at least one archaic *Homo sapiens* individual (Movius, 1956; Pei et al., 1958; Qiu, 1985; Wu and Poirier, 1995).

The Dingcun lithic assemblage comprises over 2,000 implements, including large flake tools and stone spheroids (also known as ''bola balls''). These artifacts are produced from high quality hornfels that is exposed naturally in rocky outcrops roughly 10 km west of Dingcun (Pei et al., 1958; Qiu, 1985; Gao, 2000). Direct percussion and bipolar techniques were utilized in the manufacture of these assemblages. Some evidence of platform preparation is present as well. Dingcun is best known for the presence of picks and cleavers, some of which measure upwards of 18 cm in length. This differs from the more traditional East Asian lithic assemblages that generally include core and small flake implements (Pei et al., 1958; Qiu, 1985; Clark and Schick, 1988; Gao, 1999, 2000; Keates, 2001; Gao and Norton, 2002).

Since 1973 Acheulean handaxe-like stone tools have been surface collected and more recently found *in situ* during excavations of primary deposits in the Bose Basin in the Guangxi Zhuangzhu Autonomous Region of southern China (Huang, 1987, 1989, 1993; Olsen and Miller-Antonio, 1992). The heavy-duty implements are quite large, with some measuring

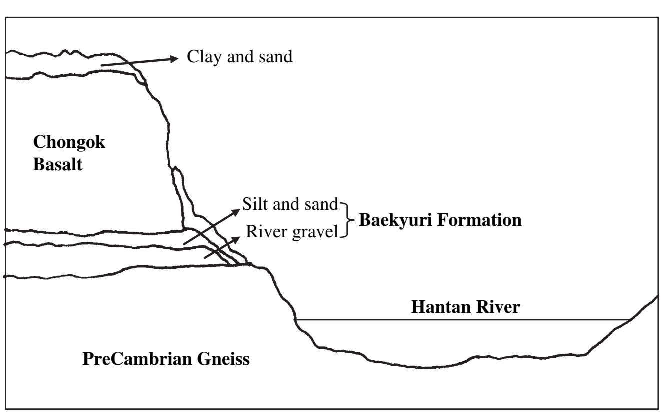

Fig. 8. Lithostratigraphic reconstruction of IHRB region, Korea. The primary stratigraphy of interest is the Chongok Basalt, where the basal layer (thought to have formed by a single flow) appears to date to ca. 0.5 Ma and the upper levels to the Terminal Pleistocene. Handaxes were recovered *in situ* from the Chongok Basalt and the sandy/clay layers overlying it (after Bae, 1989; see text for further discussion).

Table 2
Compilation of dates for IHRB sites (Yi, 1996; Danhara et al., 2002; Bae, 2003). Note: Ma = Millions of years; ka = thousands of years; K/Ar = potassium/argon; FT = Fission track; TL = thermoluminescence; Tephra are: AT = Aira Tanzawa and K-Tz = Kikai - Tozurahara tephra

Site	Chronometric age	Dating method
Chongokni	<0.27 Ma	K/Ar
Chongokni	0.6 ± 0.2 Ma	K/Ar
Chongokni	0.4 ± 0.1 Ma	K/Ar
Chongokni	2.9 ± 0.3 Ma	K/Ar
Chongokni	0.6231 ± 0.018 Ma	K/Ar
Chongokni	0.5 Ma	K/Ar
Chongokni	0.51 ± 0.07 Ma	FT
Chongokni	29 ka ± 1.9 ka	TL
Chongokni	25–22 ka	AT tephra
Chongokni	95–90 ka	K-Tz tephra
Jangpari	73 ka ± 14 ka	TL
Kawoli	190 ka ± 24 ka	TL
Kawoli	235 ka ± 24 ka	TL
Kawoli	25–22 ka	AT tephra
Chuwoli	116 ka ± 7.3 ka	TL

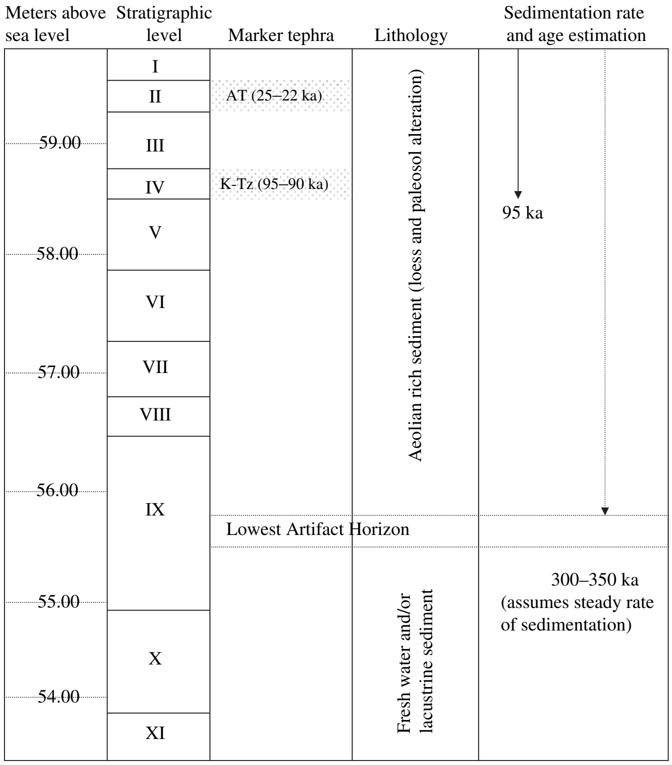

Fig. 9. Stratigraphic profile of Chongokni site correlated with tephra markers, lithology, and reconstructed sedimentation and age estimations (after Danhara et al., 2002: Fig. 18). Tephra are: AT = Aira Tanzawa and K-Tz = Kikai-Tosurahara.

up to 38 cm in length. Based on analysis of flake reduction and overall shape, the Bose handaxes have been found to be similar to materials from Olduvai Gorge Beds III/IV (Tanzania) and Olorgesailie (Kenya). The raw materials utilized by the Bose hominins were local quartz, quartzite, sandstone, and chert cobbles. A recent ^{40}Ar-^{39}Ar analysis of the associated tektites suggests an age of 803 ± 3 ka (Hou et al., 2000) for the Bose assemblage. This age makes the Bose heavy-duty stone toolkit coeval with the lithic assemblages found in the western Old World with which it shares technological similarities.

One of the most often mentioned characteristics of the East Asian bifacial implements, besides the relatively crude nature of the pieces, is how much "thicker" the tools east of the Movius Line are in relation to penecontemporaneous bifaces from Africa or the Levant (Movius, 1948, 1969, 1978; Schick and Dong, 1993; Clark, 1994; Schick, 1994). Statistical analysis was conducted on handaxes from India (Paddayya et al., 2002; Noll and Petraglia, 2003; Petraglia, 2005), Africa (Noll and Petraglia, 2003), and Korea to test this assertion. Even though the length and width measurements did not differ statistically between the handaxe assemblages from Hunsgi-Baichbal (India), Olorgesailie (Kenya), and the IHRB (Korea), thickness does differ between regions (Tables 3 and 4). T-tests indicate significant differences between the thickness of IHRB handaxes and those from Olorgesailie and Hunsgi-Baichbal (Table 4).

The variation in handaxe thickness could be a result of the original shape or the type of raw material used. Recent analysis of the handaxes from the Early Stone Age Isimila site (Tanzania) appears to support the assertion that the original shape of the

Table 3
Sample sizes, means, and standard deviations of length, width, and thickness distributions of bifaces from IHRB region (Korea), Olorgesailie (Kenya), and Hunsgi-Baichbal (India) (data for Olorgesailie and Hunsgi-Baichbal biface assemblages from Noll and Petraglia, 2003: 38). Data given in mm

Locality	Sample size	Length		Width		Thickness	
		Mean	SD	Mean	SD	Mean	SD
IHRB	58	153.86	30.46	94.16	13.92	60.19	12.92
Olorgesailie	697	161.46	41.87	93.67	19.59	41.56	10.13
Hunsgi-Baichbal	352	148.99	37.39	91.94	21.44	44.30	10.53

clasts and the type of raw material are important factors in the production of more sophisticated handaxes west of the Movius Line (Bae et al., 2004), although clearly other dynamics are involved as well (Petraglia, 1998). Generally, the IHRB bifaces were produced on thick river cobbles, whereas those from East Africa were produced on large flakes, with a smaller percentage made on cores/clasts (Isaac, 1977). IHRB bifaces were produced on quartz, quartzite, and basalt, whereas at Hunsgi-Baichbal, limestone, granite, and dolerite were used, and at Olorgesailie, basalt, phonolite, and trachyte were used (Paddayya and Petraglia, 1993; Norton, 2000; Noll and Petraglia, 2003; see also Jones, 1979). Nonetheless, in many excavations from the Indian subcontinent, refined quartz and quartzite bifaces have been recovered (Misra, 1987, 1989), suggesting that raw material type alone does not dictate the overall morphology of the biface.

Even though the observed variation of the handaxe thickness east and west of the Movius Line is statistically significant, more detailed comparative analyses of the lithics are critical to developing a clearer understanding of the variation in stone toolkits across the Old World. In particular, differences between South and East Asia, which are separated by the Himalayan Mountain Range, require further study (see Petraglia, 1998; Leng and Shannon, 2000). For instance, analysis of flaking patterns of South and East Asian bifaces may illustrate technological variation and/or how heavily utilized certain raw materials were used in each region.

Discussion

Were East Asian hominins capable of producing sophisticated stone tools? If the stone toolkits from Bose, Dingcun, and especially those from the IHRB region in Korea (e.g., Chongokni, Kumpari, Chuwoli, Kawoli) were included in the response to the question, then despite the apparent "thick" trait of the East Asian heavy-duty implements, and the fact

Table 4
Corresponding T-scores when IHRB handaxe metric data was compared with biface assemblages from Olorgesailie (Kenya) and Hunsgi-Baichbal (India). Refer to Table 3 and Appendix for sample sizes, means, and standard deviations for the lengths, widths, and thicknesses derived from the different handaxe assemblages used to determine the T-scores

	IHRB		
	Length	Width	Thickness
Olorgesailie	1.77	0.25	10.71*
Hunsgi-Baichbal	0.40	1.03	8.89*

* T-score significant at 0.05 level (two-tailed).

that it has been noted that the Bose heavy duty tools have a higher cortical butt cortex and are unifacial, rather than bifacial (cf., Hou et al., 2000), the answer would still have to be yes. Nevertheless, after over a half-century of intensive paleoanthropological research in East Asia should we discard the Movius Line, as some have argued in the past (e.g., Yi and Clark, 1983)? In the strict sense of the term, the Movius Line is not supportable (i.e., absolute presence/absence). However, if a map of East Asian Paleolithic sites were drawn, the conspicuous lack of biface-bearing sites in East Asia is still prominent, despite over 80 years of paleoanthropological research in this region of the Old World. It is not the intent here to diminish the importance of the number of East Asian Paleolithic archaeological sites that have exposed handaxes, cleavers, and picks in situ and as surface-finds.

By the Middle Pleistocene, East Asian hominins had the ability to produce sophisticated stone tools, which implies similar levels of enhanced planning aptitude and technical competence as those hominins in Africa. Nevertheless, as Movius (1944, 1948) observed over a half-century ago, East Asian Pleistocene hominins utilized different tools to carry out their everyday activities than did hominins in other regions. Three primary conclusions drawn from this study that are directly related to Movius' observation include:

1. Compared to East Africa and India, the frequency of handaxe sites in East Asia is significantly lower.
2. The percentage of bifaces in these East Asian lithic assemblages is usually much lower than coeval sites from India and East Africa.
3. East Asian handaxes are not morphologically similar to typical western Old World Acheulean implements (based on thickness here, but also in other attributes and dimensions).

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Appendix. Length, width, thickness, elongation, and refinement measurements of handaxes from IHRB sites (from Yi, 1989; Choi, 1994; Bae et al., 1995; Yoo, 1997; Bae et al., 1999). Raw data in centimeters. Arbitrary artifact numbers assigned to the handaxes

Site	Artifact #	Length	Width	Thickness	L/W	W/T	L/T	Elongation (L/W)	Refinement (T/W)
Chongokni	1	17.30	8.50	6.90	2.04	1.23	2.51	2.04	0.81
	2	17.50	9.60	6.40	1.82	1.50	2.73	1.82	0.67
	3	16.80	8.30	5.90	2.02	1.41	2.85	2.02	0.71
	4	17.60	10.20	7.50	1.73	1.36	2.35	1.73	0.74
	5	18.10	8.70	8.90	2.08	0.98	2.03	2.08	1.02
	6	17.80	10.70	6.40	1.66	1.67	2.78	1.66	0.60
	7	13.45	8.62	5.87	1.56	1.47	2.29	1.56	0.68
	8	10.80	8.00	6.80	1.35	1.18	1.59	1.35	0.85
	9	15.50	8.94	4.87	1.73	1.84	3.18	1.73	0.54
	10	12.70	10.10	4.50	1.26	2.24	2.82	1.26	0.45
	11	13.90	8.50	4.50	1.64	1.89	3.09	1.64	0.53
	12	12.40	10.80	4.30	1.15	2.51	2.88	1.15	0.40
	13	20.00	9.70	3.00	2.06	3.23	6.67	2.06	0.31
	14	17.90	8.50	5.50	2.11	1.55	3.25	2.11	0.65
	15	12.90	8.90	7.70	1.45	1.16	1.68	1.45	0.87
	16	11.70	8.90	7.70	1.31	1.16	1.52	1.31	0.87
	17	13.00	10.10	6.80	1.29	1.49	1.91	1.29	0.67
	18	11.00	8.50	6.00	1.29	1.42	1.83	1.29	0.71
	19	12.20	9.34	5.96	1.31	1.57	2.05	1.31	0.64
	20	13.00	10.00	6.30	1.30	1.59	2.06	1.30	0.63
	21	11.40	8.30	6.50	1.37	1.28	1.75	1.37	0.78
	22	15.50	9.62	6.70	1.61	1.44	2.31	1.61	0.70
	23	16.90	10.30	8.40	1.64	1.23	2.01	1.64	0.82
	24	12.30	9.00	5.40	1.37	1.67	2.28	1.37	0.60
	25	14.40	9.60	7.80	1.50	1.23	1.85	1.50	0.81
Chuwoli/Kawoli	26	16.70	9.20	5.90	1.82	1.56	2.83	1.82	0.64
	27	17.70	8.90	4.40	1.99	2.02	4.02	1.99	0.49
	28	14.60	8.50	5.10	1.72	1.67	2.86	1.72	0.60
	29	16.80	7.50	6.00	2.24	1.25	2.80	2.24	0.80
	30	17.90	8.40	5.30	2.13	1.58	3.38	2.13	0.63
	31	15.10	8.00	4.20	1.89	1.90	3.60	1.89	0.53
	32	17.10	10.60	6.40	1.61	1.66	2.67	1.61	0.60
	33	19.40	11.50	6.40	1.69	1.80	3.03	1.69	0.56

Appendix (*continued*)

Site	Artifact #	Length	Width	Thickness	L/W	W/T	L/T	Elongation (L/W)	Refinement (T/W)
	34	17.30	10.30	5.00	1.68	2.06	3.46	1.68	0.49
	35	14.70	7.10	6.20	2.07	1.15	2.37	2.07	0.87
	36	13.60	10.10	4.90	1.35	2.06	2.78	1.35	0.49
	37	17.30	9.10	5.90	1.90	1.54	2.93	1.90	0.65
	38	14.70	8.90	5.30	1.65	1.68	2.77	1.65	0.60
	39	18.40	10.30	8.40	1.79	1.23	2.19	1.79	0.82
	40	20.50	12.70	7.60	1.61	1.67	2.70	1.61	0.60
	41	23.90	13.90	7.60	1.72	1.83	3.14	1.72	0.55
	42	17.90	9.40	5.80	1.90	1.62	3.09	1.90	0.62
	43	14.50	10.00	4.80	1.45	2.08	3.02	1.45	0.48
	44	13.90	8.50	5.50	1.64	1.55	2.53	1.64	0.65
Kumpari	45	12.30	8.20	4.80	1.50	1.71	2.56	1.50	0.59
	46	14.30	8.80	4.60	1.63	1.91	3.11	1.63	0.52
	47	17.80	10.20	6.40	1.75	1.59	2.78	1.75	0.63
	48	11.30	8.20	5.70	1.38	1.44	1.98	1.38	0.70
	49	21.80	11.40	6.40	1.91	1.78	3.41	1.91	0.56
	50	13.30	9.00	6.20	1.48	1.45	2.15	1.48	0.69
	51	20.70	12.40	5.90	1.67	2.10	3.51	1.67	0.48
	52	15.10	11.70	6.50	1.29	1.80	2.32	1.29	0.56
	53	16.30	9.30	6.00	1.75	1.55	2.72	1.75	0.65
	54	15.90	9.80	7.00	1.62	1.40	2.27	1.62	0.71
	55	13.00	10.40	6.10	1.25	1.70	2.13	1.25	0.59
	56	10.10	5.80	3.10	1.74	1.87	3.26	1.74	0.53
	57	10.60	7.40	4.20	1.43	1.76	2.52	1.43	0.57
Namkaeri	58	11.86	8.93	8.93	1.33	1.00	1.33	1.33	1.00

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